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ABSTRACT

This conference report provides a general view of the problems arising in the education and utilization of qualified manpower and the possibility of identifying the policy measures needed in order to facilitate their solution. Part I of the report gives an account of the proceedings of the conference. Part II presents extracts from or summaries of the principal reports presented. Within this portion of the report are presentations on: (1) the balance between need for and resource of scientific and technical personnel; (2) moving toward a better utilization of scientific and technical personnel; and (3) institutional aspects of the development of national policies. (HS)

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POLICY CONFERENCE ON HIGHLY QUALIFIED MANPOWER

PARIS 26th-28th SEPTEMBER 1966

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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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- *to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development;*
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of the Development of National Policies

PREFACE

The Conference, an account of which is given in the present publication, was held in Paris from 26th to 28th September 1966, and provided an opportunity for an exchange of views between national delegates for 19 OECD Member countries on the education and utilisation of scientific and technical personnel.

The need for a confrontation of national experience in this field has made itself felt in various ways. Member countries are becoming increasingly conscious of the significant role their resources in scientific and technical personnel play in present economic development and future possibilities of expansion. The difficulties met by developing countries show that the exploitation of scientific and technical knowledge for productive ends is possible only if countries have sufficient highly qualified personnel at their disposal, and adopt practices and policies through which such personnel is nationally utilised.

Study of these problems has been one of the main concerns of the programmes of the OECD Committe for Scientific and Technical Personnel for several years. These programmes have in a general way contributed to a better appreciation of the limits between investment in education and economic growth, and of the changes needed to educational practice and systems if they are to adequately meet the needs of modern societies. In this respect, particular attention has been paid to the education of scientific and technical personnel, and the additional efforts which are necessary in this field if the quality and quantity of such personnel are to be made relevant to the needs of the economy.

The rapid increase which has taken place in most Member countries in the provision of training for scientific and technical personnel has led to the recognition of the need to investigate the relationship between the type of job graduates are doing with the education they have received. Decisions concerning the careers of this category of personnel, taken at labour market or firm level, may result in highly qualified staff occupying jobs which do not correspond to the education received, and which frequently means the under-utilisation of such personnel.

The reports submitted to the Conference, consisting of studies initiated by OECD in various countries, provided a general view of the problems arising in the education and utilisation of qualified manpower and the possibility of identifying the policy measures needed in order to facilitate their solution. There was general agreement concerning the need of basing such policy measures on objective information resulting from serious study and research. Delegates felt that the elaboration of such policies devolves upon national authorities at the highest level and that it was desirable for each country to make the necessary arrangements to ensure close co-operation between those responsible for educational and professional training and those responsible for employment.

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PROCEEDINGS OF THE CONFERENCE

INTRODUCTORY STATEMENT: MANPOWER AND EDUCATION

by
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This Conference deals with the dynamics of the relationship between a country's educational institutions and its employing enterprises.

There are, of course, many points of contact between these two national institutions. None, however, is more important than their one common denominator which is also the ultimate bridge between them: the people with whom both are engaged.

It should be made clear at the very start, therefore, that whatever the vantage point from which one views and deals with the critical interactions between manpower and education, whether it be in education itself, or in business or government service, the touchstone always turns out to be the individual - and his or her interests, motivations, aptitudes and talents, and the provision of a climate which permits their maximum development and utilisation.

It is significant that in a recent study of the role of education in a technological society, the following was given first place:

"Our position is that the guiding concept of education for the American people is individual opportunity, and that education should be directed primarily to assisting individuals to cultivate their talents. The strength of the Nation, in whatever area - be it defense, manpower, social relations, or government - is dependent upon our success in providing ample and excellent opportunities for individuals to become truly educated...

"The same principle also seems to be applicable in manpower development. If industry or government is found with a shortage of electronic technicians or quality-control experts, some types of institutions may be properly called upon to provide facilities for training workers in those fields. But individuals should be free to choose and schools free to determine -without threat of penalties- whether or not they will enter these fields". (1)

This is a matter of great import both in principle as well as practice. It means that programmes and policies devised to establish the desirable relationship between manpower and education will have to take into account, as indeed they must for practical reasons, the whole constellation of forces which impinge upon the individual. The significant amount of attention, for example, paid in many of the Conference papers here to the matter of motivation among highly qualified personnel in both their education and employment is testimony to this point.

Thus, education involves a wide variety of goals, as part of the transmission and enhancement of a country's culture - in the development of the individual himself as a person and as part of a family; in the preparation of the individual for intelligent participation in community affairs; in the provision of transactions with the environment which will enable the individual to appreciate his cultural milieu; and in the unfolding of the understandings which ensure the individual's proper role in his economic environment, in providing the goods and services needed by a nation's current level of living, as well as those required by a rising standard of living - the latter particularly true for highly qualified personnel.

In accepting the challenge of understanding and perceiving the relationship between manpower and education within the context of the importance of the individual, this Conference can respond to the overall policy questions being put to those who have responsibilities for educational policy and those who direct the programmes of employing enterprises by considering the following three propositions.

1. In assessing the response of the educational system to its economic environment, the function of education can be viewed as <u>the process which enables an individual to withstand the inevitable changes which will occur in the relationship between what he learns and what he will be called upon to do in the world of work</u>. (2) Such a definition, with its focus on the individual, argues for the broadest based kind of education so that he attains maximum responsiveness, adaptability, flexibility in the face of manpower, industrial, occupational and technological change.

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(1) "Educational Implications of Technological Change",in Technology and the American Economy", National Commission on Technology, Automation and Economic Progress. Washington, DC, Government Printing Office. Feb.1966, Appendix Volume IV, p. 79.

(2) This concept of the educational process is detailed in Wolfbein, S.L.: "Education and Employment" in "The Nation's Children", Ginzberg, (ed). 1960 White House Conference on Children and Youth, N.Y. Columbia University Press, 1960. Vol. 2, pp. 138-157.

Such a definition challenges the more traditional and simplistic labour market approaches to the manpower-education phenomenon. Mr. Hugh Folk in his conference paper (1) concludes that "If we consider the performance of higher education in terms of decades, we must conclude that higher education in both the United Kingdom and the United States has responded to economic needs" and remarks that "In terms of shortages definable in labour market response higher education in both countries has served well. This is especially remarkable in that neither system was designed or is currently managed to meet broad economic needs for trained manpower".

May not this be the very point, however ? Perhaps it is not remarkable at all, perhaps this is exactly what happens in the USA for example, where education tends to focus on the individual and on preparing him for what hopefully will be the most flexible stance vis-a-vis changing occupational requirements.

Such a definition also challenges the equally simplistic conception of the possibilities of a straight feedback from occupational projections, through educational requirements for various occupations, to the educational system as the provider of the necessary numbers called for. Such a conception has to face up to at least three points, emphasized recently in such writings as those of Parnes (2) and in the present conference paper by Messrs. Blaug, Peston and Ziderman (3).

The first of these involves the nature and conditions of occupational projections and therefore their use in shaping the educational destinies of a population. To argue by use of extremes: what kind of manpower-education feedback would have ensued from occupational projections in the depression decade of the 1930s? Is it possible, now that we can view that decade from hindsight, that the best feedback would be in the form of our definition used at the beginning of this section? - as indeed it turned out to be for most university trained persons of that time. In the more prosperous decade of the 1960s, a new vocabulary indicative of brand new categories of professional jobs - ferret reconnaissance, inertial guidance, human factors science, etc. - raises the query of how the response mechanism operates in terms of short term changes which often are the producers of shortages and other frictions in the manpower-education constellation.

The second of these, underscored by the Blaug, Peston, Ziderman paper previously referred to, opens the serious question of the educational prerequisites for various occupations in real-life situations, and points to the enormous work still to be done in giving this factor the parameters needed to make it a viable force in any kind of bridge between the educational system as producer and employing institutions as users of highly qualified talent.

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(1) "The Response of Higher Education to Economic Needs", p. 29

(2) Cf., e.g., Forecasting Educational Needs for Economic and Social Development", OECD Paris 1962, as well as his comments in "Occupational Data Requirements for Education Planning". Proceedings of a Conference. Madison, Wisconsin, University of Wisconsin, 1966, pp. 116-123.

(3) "The Utilization of Qualified Manpower in Industry".

As the three authors say "It cannot be taken for granted that only one occupational structure will fulfill the ultimate production requirement ... the connection between occupation and education also may not be a simple one. As will be explained later there may not in most cases be a single educational requirement for each occupation" (1). At the same time, it is hardly true that one kind of education is preparatory for only one kind of occupational deployment. As was pointed out: "If we maintain that it is conceivable that a larger part of, say, engineering graduates will end up in non-engineering functions, it is obvious that an expansion of a technical facility that takes into consideration only the future needs of engineers might be a serious underestimate".
The third of these is the turn-about possibility of reversing the feedback and moving toward a response by employing institutions to the characteristics and profile of a nation's labour force. As this writer has said elsewhere in a broader context "the manpower matching and mobility dimension of an active manpower policy includes not only such mechanisms as the employment service and various methods for helping to get people to the right place at the right time for the right job, but also those actions which redesign and alter the job structure itself to fit available labour supply. Included in the latter are programmes which might change actual job content or job prerequisites for employment..." (2) Such an eventuality is also deliberately included in the Blaug, Peston, Ziderman paper which remarks that "It is perhaps also worth mentioning here that planning in this context may also be approached the other way round. An attempt might be made to determine what output would emerge (or could be made to emerge under optimum conditions) from a labour force of given educational or occupational characteristics" (3). All of this underscores the role of the employing institutions to which we now turn.

2. In his excellent paper prepared for this conference, E. Thorsrud of Norway says that "Education and work are not only means to an end but represent also basic values in human life" (4). Certainly, as is true of education, employing enterprises also provide the opportunity for satisfying a wide variety of goals. They exist to provide the goods and services demanded by a country's domestic and international consumers; but they also represent the arenas for the development of the very individual interests, motivations, aptitudes and skills to which reference has been made; they represent the milieu for the creative work, the research and developmental activities, the actual provisions of goods and services which enhance the country's economy - a factor again of forceful relevance to the highly qualified personnel who are the subjects of this conference.

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(1) Ibid., p. 9.

(2) In "Employment, Unemployment and Public Policy", N.Y., Random House, 1965, p. 162.

(3) Op. cit. p. 9.

(4) "A Social Research Approach to the Education and Utilization of Engineers", p. 4.

Such a conception of the role of the employing enterprise yields a view of its function analogous to our definition of education: In assessing the response of the entrepreneurial system to the educational and training environment, its function can be viewed as the process which enables the individual to withstand the continual changes which occur in the relationship between what he is called upon to perform in the world of work and what he has learned in the world of education.

In this connection, Blaug, Peston and Ziderman again make a perceptive comment when they note that under modern conditions "The firm is just as unlikely to want its trained labour to leave it, as it is to give away its machinery" (1). The fact of the matter is that trained labour, especially in the form of highly qualified talent, represents a critical investment of relatively high purchase cost, to be maintained in an up-to-date position in an ongoing programme of refurbishment, re-endowment, retraining.

Thus our definition in this case also challenges a traditional view, this time of management's view of labour and labour cost - and underlines most significantly the paramount role of imaginative recruitment, utilization and career development of its personnel.

3. It turns out therefore that focusing on the individual reveals a substantial amount of potential congruence in the aims and goals of the two institutions being considered at this Conference. The common boundaries of the two are significant and substantial. Both are affected by a variety of exogenous forces as well, e.g., levels and trends in economic growth to which they, in turn, also contribute. The ebb and flow of economic activity as it affects support of public education or as it impinges on the demand for highly qualified talent, for example, is referred to many times in a number of Conference papers.

Of similar consequence is national government policy, so effectively documented in this, the latter part of the 20th century, by the enormous rise in the use of economic policy to generate employment growth and equally significant advances in manpower policy with its heavy commitment to education and training.

Developments in individual countries underscore the importance of the general subject of this Conference in this context. In the USA, for example, to cite a specific and concrete illustration:

Net increase in USA Labour Force 1965-1975	(Millions) 15.3	100 (%)
14-24 years of age.	5.7	37
25-34	6.1	40
35-44	-.9	-6
45+	4.4	29

(1) Op. cit. p. 20.

In the decade 1965-197[illegible] [illegible]re will actually be about one million fewer workers in the critical a[illegible] [illegible]p 35-44 - an age group from which a nation normally expects to begin to elicit personnel - especially among highly qualified personnel with their relatively heavy investment in education - with the kind of career developme[illegible] enabling them to take on positions of leadership in business, industry, government and education. Yet it is exactly here that a substantial diminution in numbers is scheduled to take place.

The way in which a nation positions itself vis-a-vis this kind of manpower profile and many of the other manpower phenomena discussed in the Conference papers becomes a matter of major import and inevitably stresses the reacting and interacting relationships between these phenomena and education and industrial and business enterprise.

How shall these be consummated

The OECD Secretariat, in its draft programme holds that "It is recognized that the role of the educational system in preparing the population to participate in economic life is an important consideration in formulating development policy. This objective in no way contradicts broader cultural and social goals which the educational system rightly considers to be its duty to fulfil. On the contrary, it tends to reinforce them and give them all the value they deserve".

Thorsrud (1) puts his finger, however, on a major problem when he notes that "... education represents values in itself and is at the same time an increasingly important factor in economic growth. Economic growth is a necessary condition for social and cultural development in general. But this does not mean that culture values represented in education of a certain culture may not be endangered if education is adjusted primarily to satisfy industrial and other economic needs".

In this connection we offer two possibilities:

The first relates to the time honored dichotemy between "education" and "training", the former usually taken to describe the first formal round of learning, the second the subsequent experiences with learning, usually proposed as more vocational in nature. If our first two propositions have some viability, however, and we really mean it when we talk of "education over the lifetime of the individual", then perhaps we are on our way toward blurring this kind of polarization. Educational institutions are not monolithic organizations: they can be and, as a matter of fact, have been flexible enough to devise a wide range of institutional responses to the needs for updating professional personnel, whether it be in the realm of a host of post-doctoral programmes or the burgeoning colleges of continuing education in the USA. Similarly, business organizations can be and have proved themselves to be not only supporters of updating programmes for personnel (one company - General Dynamics - made available one million man hours of company-paid-for instruction outside its establishment in 1964). Its own operations and environs, whether it be a high energy physics lab or a new computer setup, also can serve as arenas for the education, training and creative utilization of highly qualified personnel.

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(1) Op. cit.

The second – and this closes the circle so far as this p er is concerned – is that the discussions in the various Conferenc pers (including this one) talk of the responses to be made by the "ec cational system" and "business enterprises" to manpower problems and ie various institutional problems involved therein. It may turn out t at at least as important and meaningful a pathway for response is to move from the "system" to the individual and deal with <u>him</u> in our programmes in the manpower–education constellation, as indeed we have done with substantial success, in affording him opportunities for choice of a variety of programmes for advancement and updating provided by government, education and business.

TERMS OF REFERENCE : PURPOSE OF THE CONFERENCE

The role of the educational system in preparing individuals for their professional life in scientific and technical fields is recognised as an important element in a development policy. Although this has been explicitly stated only recently, it is in no way at variance with other cultural and social goals which the educational system has set itself. On the contrary, it helps amplify and bring out the full value of the prominent role played by education in the building of modern society.

The functions which those just completing their education are called upon to fulfil during their working lives are not determined solely by the education they have received. Decisions in this matter, taken on the labour market and in the firm as the career of a person develops, may lead to a choice of career not corresponding to the training received and to an incomplete exploitation of the knowledge and skills acquired. In view of the increasing expenditure on education in all countries, it is important to attempt a better utilisation of scientific and technical personnel.

The purpose of the Conference is to examine:

(i) Policies for adaptating the educational system to provide training in line with economic needs;

(ii) The role of employers and public authorities concerning the optimum utilisation and complementary in-career training of highly qualified personnel.

GENERAL REPORT

by Roger Grégoire, Conseiller d'Etat (France)

An Inter-Governmental Conference met in Paris from 26th to 28th Septembre, 1966, to study methods of ensuring that the supply of highly qualified scientific and technical personnel was adequate to meet the need for such personnel.

The conference was organised by OECD as a follow-up to the "Policy Conference on Economic Growth and Investment in Education" (1) held in Washington from 16th to 20th October, 1961. The aim of the first conference was to assess, on the basis of a study directed by Professor Svennilson, the quantitative effort needed up to 1970 to develop education in the OECD area, with particular reference to demographic forecasts and the trend in enrolment ratios. This assessment followed discussions on the importance of education as a factor for economic growth. All these studies undoubtedly encouraged Member countries to persevere in the efforts which most of them were already making to ensure a rapid increase in the number of persons holding diplomas in secondary or higher education.

Education is such a lengthy process that it would have been pointless to attempt, after less than five years, to measure the results achieved. The purpose of the Paris discussions was not therefore to resume but to supplement the Washington discussions. They provided an opportunity to go into the question of training requirements more closely and at the same time underlined the need to make the best use of trained personnel, in order to exploit to the full existing resources.

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(1) The report on this Conference is in five short volumes combined under one cover - Paris, OECD second edition, December 1965.

These discussions, which are summarised in the first two sections of this general report, were based on a series of special reports. They centred on four main themes which, in view of their nature and the fact that two Working Parties were set up, it was found convenient to group together in pairs:

- assessment of training requirements in the light of manpower needs and adaptation of educational systems to these requirements;
- optimum utilisation and upgrading of trained personnel, notably through the continuous education of persons in employment.

As was to be expected, the Conference revealed more gaps than progress in the knowledge of the subject under study; in fact more problems were raised than were solved. Possible measures to bridge the gaps and solve the problems are summarised in the concluding section.

I - Training requirements and adaptation of educational systems

Although mainly concerned with matching resources of highly qualified personnel to needs, the Conference was not content to assign purely economic objectives to education. On the contrary, many participants expressed the view, which was not contested, that it would be dangerous to base education policy on manpower needs alone. Such a policy would be a negation of the freedom of individuals and their right to attain the highest level of education of which they are capable. It would make little allowance for social aspirations. In fact it might even run counter to the objective pursued. As will be seen later, general culture is more important than very specialised knowledge in helping highly qualified personnel to keep up with the continuous development of science and technology. These preliminary remarks should be kept in mind when considering the first subjects discussed.

Difficulty of assessing training requirements

Matching resources to needs requires a knowledge of what the needs are. Overall estimates, of the kind made in Washington, are not enough. We need to know not only the numbers of diplomas by level of qualification, but also the types of diplomas. But, despite the progress made in forecasting, many gaps still remain and it is not altogether surprising that there should be some doubts in a number of countries about the value of overall forecasts.

The reports and oral statements made to the Conference showed that substantial improvements have been made in recent years in forecasting methods. Three examples were particularly interesting.

First, the G.T. Page report describes the methods used in France to work out training requirements on the basis of manpower needs. There are three successive stages; first, long-term manpower needs are forecast by occupation, are then expressed in terms of training, and finally in terms of educational flow by level and type of training. Once this has been done it is possible to draw up a balance

sheet of manpower and training forecasts, since the measures designed to bring the needs of the economy and the "output" of the educational system into line are no longer a matter of forecasting, but of political and administrative decisions. The report points out that manpower forecasts, and consequently forecasts of training requirements, are meaningless unless they are related to economic growth objectives. This leads to the conclusion that all forecasts tend to be normative, since they indicate targets to be achieved and not merely probable trends. It is interesting to compare this point with that made during the discussions concerning the work done in the United States by the National Science Foundation which is engaged in working out the training requirements arising out of the programmes provided for in the Federal Government's budget (1).

To judge the extent to which methods have been improved it is interesting to compare the Page report with that presented in Washington by Mr. Raymond Poignant (2). Describing the way in which the French Fourth Economic Plan (1962-1965) was prepared, Mr. Poignant pointed out that, in the absence of sufficient information on manpower needs, the numbers in universities and schools were allocated between the different types of secondary and higher education on the basis of a series of assumptions, postulating a virtually maximum increase in the scientific and technical branches. The Page report, on the other hand, shows that in preparing the Fifth Plan (1966-1970) it was possible to make allowance for changes in the structure of the active population.

Secondly, the LSE report and the statement made during the Conference by professor Moser stressed the usefulness of an analysis of "costs and income" for each type of training, discounted at various rates of interest, for the assessment of both educational needs and the yield of the educational system.

Finally, reference must be made to two United States contributions. In the first place, the Cain report shows how population census data can help in defining the links between training and subsequent occupations. Secondly, in the course of the meeting, Mr. Riley emphasized the importance of calculating the numbers of highly qualified scientific and technical personnel needed for governmental and inter-governmental programmes in such fields as oceanographical research or the study of measures to deal with congestion in towns. He hinted at the possibility of establishing models for educational development based on analyses which would be much more detailed than those made hitherto. These models would include not only the quantitative factors used in existing models (3) but also qualitative factors (e.g. nature and value of training).

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(1) For further details, see Leonard A. Lecert: "The Dollar Cost of our National Goals", Center for Priority Analysis, Research Report N° 1, National Planning Association, Washington, 1966.

(2) "Policy Conference on Economic Growth and Investment in Education", Volume 4, page 9 et seq.

(3) See in particular: "The Residual Factor and Economic Growth". Report on the work of the Study Group in the Economics of Education, OECD, Paris 1964.

The progress made must not be allowed to conceal the gaps in knowledge and information which make forecasts uncertain. The Conference drew up a list of these gaps which can be summarised as follows:

Manpower forecasts can be distorted in three ways. In the first place, most countries lack information concerning the "existing stock" of highly qualified scientific and technical personnel. One of the participants suggested that the stock available should be reviewed each year, in reports by trade organisations or Government departments. In the second place, occupational classifications are vague and in many cases out of date: the progress of technology makes it more difficult than it was fifty years ago to draw a clear distinction between functions, which in theory are immutable. Finally, it is almost impossible to say, for more than a few years ahead, how progress will affect the nature of the qualifications required: all that can be said with any certainty is that a large proportion of this personnel will have to change their occupation in the course of their working life.

There is no reliable means of relating manpower needs - assuming that these can be accurately determined - and training requirements. Many participants, for example Mr. Wolfe, of General Electric, questioned the methods used by employers in determining the criterion on which recruitment will be based. Some lay down ideal standards which cannot be met (1); others settle for what they believe, rightly or wrongly, the market can supply. In either case the vacancies offered, whether or not they are filled, afford no useful guidance to the country's requirements in regard to highly qualified personnel. Comparisons in fact show that the levels of education considered desirable in firms which carry out job analysis are very different from those actually reached by the personnel employed. Substitution therefore takes place, but its influence is difficult to determine: there is at present no criterion by which to compare the efficiency of an executive who has risen from the lower grades with that of a man specially trained for executive tasks.

In no country is the yield of education in all its forms and manifestations fully known. While it is possible, for example, to keep a fairly accurate record of the "output" of universities and similar higher education establishments, there is no way of determining how much training has been acquired outside school or university; yet it is this which makes possible some of the substitution we referred to earlier. At the same time there has been too little research into the psychological, sociological or economic factors which determine the use which young people make of the educational opportunities open to them. Even where there are extensive facilities for the vocational guidance of students the work is made difficult not only by the lack of information on career prospects in the different branches of research or production, but also by the fact that underlying motives are often unconscious, and so cannot be influenced by formal guidance.

Finally, the return on the educational system has not been sufficiently studied. The reasons which some firms have for "stocking" high

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(1) It should be noted that in many countries the standards laid down for recruitment to the Civil Service are perhaps too high.

quality personnel are not always sound (1). Until there is more research on the "cost effectiveness of education" individuals themselves will not be in a position to estimate the return on a certain type of education. One may, for instance, have serious doubts about the value of prolonged studies as opposed to early entry into active life. It would be useful if the authorities responsible for drawing up curricula could be given some guidance on this point.

It is because of these deficiencies, which forecasting experts make no attempt to conceal, that several participants, including the representatives of Germany, queried the value of attempting to establish long-term forecasts in this field. It is important to note however that even the most sceptical agreed that it would be worthwhile continuing to make forecasts, if only on an experimental basis.

There are in fact limits to what forecasts can do. Beyond 10 or 15 years it is hardly possible to do more than predict requirements by level and principal type of education. The precise qualifications needed can be foreseen only up to three to five years ahead, the interval between scientific and technical discoveries and their application. This does not mean that forecasts are useless: the educational process is sufficiently long for its adaptation to requirements - as soon and as far as possible - to be important, even if these can be estimated only in general terms. Two conclusions must, however, be drawn. In the first place, forecasts of educational requirements must never be hard and fast: they should be revised periodically as manpower needs can be seen more clearly. In the second place, in a rapidly changing world, training cannot be acquired once and for all before entry into active life.

Adaptation of educational systems

The Conference took this second conclusion as the starting point for its discussion on the changes that ought to be made in educational systems. It did not, however, go very deeply into this problem. As explicitly noted in the conclusions of one of its Working Parties, there was no intention of putting educational institutions on trial, and this was made quite clear. All the participants seemed to agree that when those responsible for such institutions were kept informed of the needs of the economy, they took the necessary steps to adapt their methods and their programmes to those needs. The only possible criticism is that this adaptation is made rather difficult owing to institutional structures and academic traditions, as the Folk Report points out. The Conference did not therefore endorse the idea, which is sometimes expressed in professional circles, that education is too attached to tradition and therefore getting increasingly out of touch with real life. On the contrary, one of the representatives of the European Federation of National Engineering Societies drew particular attention to the fact that the "grandes écoles" of technology had in recent years succeeded in making far-reaching changes in the training they provided, and this now takes account of economic and social as well as scientific and technical development.

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(1) cf. "Toward better Utilisation of Scientific and Engineering Talent, A Programme for Action", National Academy of Sciences, Washington, 1964.

This attitude is largely due to the agreement reached during the past few decades between employers and educators concerning the "stock of knowledge" which is most useful to highly qualified personnel. The nature of the qualifications required of such personnel is so uncertain that their knowledge must not be over-specialised. Furthermore, as this personnel will be called upon to perform a succession of different functions, and even perhaps make a complete change of occupation, it is important that education should develop adaptability and, more generally, individual self-reliance. This being so, the practical objectives of education can best be achieved if education concentrates on general culture. There is perhaps a need to define a culture suitable for our own time which would certainly not coincide with the "classical humanities". But the main lines of study open to students in the scientific or technical departments of universities and similar establishments include most of the elements of a modern culture. Higher educational institutions are thus being invited to enrich this culture, and not to reshape their programmes so fundamentally that they would become centres for occupational training.

During the discussions particular emphasis was put on three points. In the first place it was pointed out that highly qualified scientific and technical personnel were being associated to an increasing extent with work that had economic, social and even political aspects. Not only do many research workers or engineers assume managerial responsibilities at some point in their career, but many of them co-operate in projects - town planning, campaigns against air or water pollution, etc., where the problems to be solved are no longer essentially technical. Such personnel must therefore be given a grounding in questions which are only occasionally included in the curricula of the university departments or schools where they are trained.

In the second place, while the "basic training" of highly qualified personnel should be very broad and, as we saw earlier, of an essentially cultural character, such people are none the less required to perform certain very specific functions, calling for specialised knowledge. This specialised knowledge can soon be acquired, but it has to be taught. It is here that there is scope for collaboration between the university and industry. One of the Working Parties stressed the need to organise courses designed to familiarise graduates with actual working conditions in competitive industry. The information in the Wolfe Report about the arrangements made for the higher grade personnel of General Electric to enable them to complete their university training, and the details given at the conference itself about refresher courses for executive staff of the Siemens factories, indicate that useful steps in this direction have already been taken.

Finally, a well-adapted educational system is useless if young people do not make sufficient use of it. As already mentioned, there is little information available on the factors influencing students' choice of subjects for study. But it seems obvious that among these factors career prospects carry the most weight. The way in which personnel already in employment are used thus influences the training of the future labour force.

II - Utilisation and professional development of highly qualified scientific and technical personnel

One of the ways of ensuring that the supply of highly qualified personnel is sufficient to meet the need for such personnel is through the best possible utilisation and development of the talents available. This is in fact the only way to make good existing deficiencies, as the training of the younger generations is bound to be a gradual process. It is interesting to note that the Conference, when formally confronted with this problem, had some difficulty in deciding how to tackle it, and in the end dealt with only part of it. Moreover the need for better utilisation has so far been recognised only in the United States, where there was a committee for the utilisation of scientific and technical manpower from 1961 to 1964, and in Great Britain, as indicated in the LSE Report and statements by members of the British Delegation. The need to encourage the professional growth of such personnel is more generally recognised, since earlier training becomes out of date as a consequence of scientific and technical progress. These two points will be examined in turn.

Optimum utilisation of talent

Right from the start of the discussions in the Working Parties on the optimum utilisation of highly qualified personnel, the question was raised as to whether the concept itself was valid. Several participants also felt that the concept "misutilisation of highly qualified personnel" was not sufficiently clear. A recommendation was therefore forwarded to the OECD Secretariat, asking for a report to be prepared defining optimum utilisation and indicating the criteria by which the degree of effective utilisation could be assessed in the various countries.

One of the explanations for this reaction is to be found in the results of economic surveys. While there is general agreement that the numbers of highly qualified personnel are not sufficient, it is nevertheless very difficult to make an adequate assessment of this situation. The LSE and Page reports are very explicit on this point. Economic analyses show there to be a steady equilibrium, not a deficit, between supply and demand. A substantial rise in the level of salaries of the personnel in question has not been observed anywhere, and the rate of return on higher education, to the extent that this can be calculated, is lower than on secondary education. In many countries there is a high proportion of graduates remaining unemployed once their studies have been completed, (1) which proves that the financial inducement is limited.

Is the view that at present resources and requirements for highly qualified personnel are out of balance therefore an illusion? It certainly is, if allowance is made for the fact that the labour market can always achieve equilibrium, on the one hand because of the possibility of substitution, and on the other because manpower resources determine the volume of research and production. However, as we have already

(1) Cf. Postcensal studies.

pointed out, we have no reason to regard substitution as anything but a makeshift solution which may well undermine the productivity of the firms concerned. And, as is clear from the Folk Report, latent imbalances, hardly discernible in normal circumstances, become fully apparent when a rapid expansion of research or production is envisaged. The most striking example occurs in connection with major programmes launched by the United States Government. Their implementation may call for large-scale manpower transfers which give rise to shortages in sectors of traditional activity. Conversely, any toning down of these programmes leads to periods of unemployment. (1) In other words, the quantitative or qualitative lack of highly qualified personnel shows itself in - and might be measured by - the delay in implementing new projects, in short in the slowing down of growth.

The fact remains, however, that in most countries, where violent shifts of this kind in the demand for labour are not known, the feeling that requirements for highly qualified personnel are unsatisfied is not sufficiently strong for any measures to be taken to increase the volume of personnel at present available. The Conference did not go into this question, although reference was made to it in some reports. There would seem to be a gap here that might be filled later. Three aspects, at least, are worth studying. First, the ways in which some of the unemployed graduates, particularly women, might be encouraged to take up employment. It would be useful to discover the economic or sociological reasons for this refusal to make use of the training received. Secondly, the organisation of systematic retraining procedures. Although a move has, occasionally, been made in this direction in a number of countries, highly qualified personnel do not usually benefit. Employers and governments are somewhat inconsistent when they speak of shortages and at the same time allow trained personnel to become unemployed or under-employed on the grounds of age. Thirdly, worker training for promotion, which may be an important source of highly qualified technical personnel if not of scientific personnel. It is to be regretted that, although the Conference had a long discussion on adult education, this angle was not considered.

Greater stress was laid on what has sometimes been called "wastage" of personnel in employment. Without wishing to prejudge the findings of the report which the Secretariat was asked to prepare, an attempt might be made to discover actual cases where it is possible to speak of wastage. The transfer of research workers or technicians to management functions cannot be regarded as an economic loss either to the firm or to society. On the other hand, wastage certainly occurs when a highly qualified man is given tasks which could normally be carried out by less highly qualified personnel. Statistics show, however, that the number of assistants normally available to research workers or engineers varies considerably from one country to another, which suggests that in certain cases those concerned are unable to delegate routine tasks. Finally, it can be argued that wastage occurs when a graduate holds a post, even a high-level post, which in no way corresponds to the training he received.

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(1) "Toward better utilisation..." op. cit.

The study in the Orr Report of engineering responsibility levels in the United Kingdom, and the Swedish report on the changes in the tasks and functions of engineers in the course of their professional life, give some indications of a possible basis for assessing this wastage. But these indications are still not sufficiently complete to enable any general conclusions to be drawn.

With regard to what could be done to improve matters in this respect, the Conference did no more than review possible remedies. Three of these are worth mentioning again. The first would be a better distribution of functions, to provide highly qualified personnel with an adequate number of assistants. These assistants must, however, be available on the labour market, and this justifies the efforts made in many countries to develop secondary education and, through it, the training of technicians. From this point of view, the French experiment, the creation of University Institutes of Technology, is particularly interesting.

Another remedy might be for employers to organise the careers open to highly qualified personnel, so as to guarantee them normal prospects of promotion in the field they have chosen. These prospects should relate not only to material advantages but also to increased responsibility. In this connection the LSE study shows the importance of the classification systems used by firms and, more generally, the advantages to be gained from a consistent personnel policy. In discussion, some participants pointed out that the very structure of firms, the sharing of responsibility, and the way certain people were subordinate to others, could be the decisive factors in determining whether research workers and engineers continued in their particular line, or instead transferred to a completely different field in the course of their career.

Finally, the mobility of highly qualified personnel should be improved. In many cases such personnel cannot "make a career" in a single firm. Yet in many countries, although the need for occupational mobility is generally recognised, transfers are still frowned upon and nothing is done to encourage them. To facilitate such transfers it is not sufficient to set up good employment services; a completely new approach is required.

Professional development of highly qualified personnel: permanent education of personnel in employment

During the past ten years permanent education has become the leitmotiv of every conference at which training has been discussed. However, very little has been done so far, and in the few countries, such as the United States, where measures have been taken, they do not seem to have been sufficiently well coordinated. Is it possible that so much talk about continuing education is simply a way of making excuses for the lack of any practical achievement? The Conference was determined to do better than this. Not only did it discuss the experiments described by Mr. Wolfe and Mr. Chapuy, but one of its working parties devoted a great deal of time to the definition of measures that might be taken to make in-career training a reality.

The Conference was primarily concerned with the need to maintain and improve the qualifications acquired. It endorsed Sir Willis Jackson's view that it was absurd for society to spend considerable resources on giving 2.5 per cent of the number in each age group the highest level of qualifications and then allow this capital to depreciate. It was perhaps

a pity that the Conference did not consider other aspects of in-career training, in particular its value in promoting social upgrading and facilitating transfers to other fields. The report submitted by the Working Party points out that the upgrading of skills implies acquisition of the competence necessary to hold specialised jobs, development of the ability to adjust, and intellectual abilities such as the ability to take decisions. The Working Party felt that in-career education should as far as possible expand step by step with the development of science and technology, and therefore considered it essential that heads of firms should pick out from among their highly qualified personnel those capable of contributing to this progress, in order to help them to develop and use their own abilities.

A certain number of comments made during the discussions are worth recording. In the first place, in-career training, like basic training, must be organised in the light of manpower forecasts. Some firms, which are making considerable efforts with regard to further training, do not reap the benefit they might because they fail to define the types of men they intend to train. It is interesting to note that about 50 per cent of the 35,000 members of the technical staff of General Electric are employed in work other than that for which they were trained.

In the second place, in-career education demands an effort, and, especially, personal motivation, on the part of each individual. Experience has shown that it is those who have received the best training for their work who are most keen to take advantage of facilities for further education but in many cases they would benefit from guidance concerning their real abilities and the opportunities which the upgrading of their training can offer them. The opinions and advice of their superiors are not sufficient, either because they are not objective or, most frequently, because they are not presented in an acceptable manner. It is therefore essential to provide facilities for the guidance of adults on the lines of those available to students.

In the third place, continuous education for adults is extremely costly, if the fees for instruction and the salaries paid during courses or training programmes are borne in mind. It is estimated that these costs are two or three times higher than those for university education of the same duration. Furthermore, the average duration of careers in large firms such as General Electric is becoming shorter, mainly because young men start work later, owing to the prolongation of studies, and leave sooner owing to increasing manpower mobility. As a result the cost of education in relation to the productive activity of each individual tends to increase. Large firms are able to bear this cost. Small or medium-sized firms, on the other hand, cannot retrain their own personnel without some help.

The Conference considered the institutional arrangements which would make it possible to mobilise all the intellectual and financial resources available to develop in-career education to the maximum. It was essential that there should be collaboration between firms in the same occupational category, between employers and higher education establishments, and finally, at least in certain countries, between business circles, Universities and Government departments. The Conference noted the opportunities offered in the United Kingdom under the Industrial Training Act, and in France by the recent Bill on Vocational Training

and Guidance, which among other things provides for a series of agreements between the State and public or private bodies concerned with adult education.

III - Steps to be taken to ensure that the supply of highly qualified personnel is commensurate with real requirements

All the discussions summarised in the first two sections of the report brought out, from the point of view of knowledge, the inadequacy of information, and from the point of view of action, the wide dispersion of responsibility. If therefore it is desired to prevent imbalances between resources and needs for highly qualified personnel, both now and in the long term, efforts must be made in two directions: to acquire by research the additional information necessary to study the problem, and to enlist the co-operation of all the parties concerned in dealing with it. In both cases it is at national level that these measures must be taken, but it would be useful if Member countries were to compare the results obtained and the difficulties encountered.

The need to improve information and methods of studying the problem

The main steps to be taken fall into three groups. The first group concerns forecasts of training requirements on the basis of forecasts of manpower needs. A fairly full list was given in the first section. The second part of the Page report also contains some valuable indications of the type of surveys which would make it possible to fill some of the gaps. There is therefore no need to say any more on this, except to emphasize that it is not merely a question of further improving the statistical machinery. On the one hand a certain number of basic concepts, the classification of functions for example, must be revised. On the other hand, to throw light on certain questions, for instance the factors influencing the yield of the educational system, sociologists can make as important a contribution as economists.

The second group of requirements concerns information about the utilisation of highly qualified personnel. This question, too, has already been dealt with. We need stress only the advantages to be gained from better knowledge of substitutability between types of training, the nature of the careers open to research workers and engineers, and why there is such a relatively large amount of graduate unemployment.

There is, finally, a third series of things to be done concerning the education of people in employment. Research should proceed in two directions - first, into the motivations which cause adults to continue their education, and the guidance necessary in this field; second, into teaching methods, about which all we know at present is that they will have to be quite different from those used at school and university level.

The improvement of statistical machinery in the strict sense of the term is in most countries the responsibility of Government Departments. As for research, it seems preferable for this to be done by independent institutions. The Conference noted with interest the role played in the London School of Economics by the Unit for Economic and Statistical

Studies on Higher Education, and the increasing number of projects entrusted to other institutions by the National Science Foundation. In the opinion of participants the Thorsrud Report proved the effectiveness of the sociological approach.

Even in countries such as France, where it is usual to work with global forecasts, some of the necessary surveys must be conducted within enterprises themselves. The Page Report makes this point very clearly. This applies even more to countries such as Great Britain which attach more importance to assessments made by employers or trade associations. Several participants, however, drew attention to the difficulty which research workers had in obtaining access to workshops and laboratories and, more generally, in gaining the confidence of heads firms. It is essential that the latter realise how much it is in their interests for knowledge to be improved. Once they do realise this, industry may well give not only moral but financial support to institutions engaged in research on employment and education.

The need to ensure that all the parties concerned cooperate in dealing with these problems

In opening the Conference, Mr. Seymour Wolfbein enumerated the parties interested in the training and optimum utilisation of highly qualified scientific and technical personnel. These parties were individuals, educationists, employers and Governments. The Conference defined the role of each and stressed the importance of institutional arrangements for collaboration between them.

The Conference stressed several times that it was the individual who mattered most. As one of the speakers said, "if we can solve the problems of the individual, we shall have solved the problem as a whole". One of the Working Parties concluded its report with a paragraph on "human values" which is worth quoting in full:

> "Technological know-how cannot be divorced from the scientific and philosophic ... exploration of "what is". The harmonizing of technology with man's enduring spiritual, social and political needs must be done, not sometime in the future when we have more time to think about it, but as we go along ... We must view these factors with a deeper understanding of the meaning and purpose of the goals towards which we aspire as members of the entire human family".

At no time therefore, did the Conference envisage measures which, by a process of selection and screening, would compel individuals to select or abandon this or that vocation. It also felt that efforts to acquire training and to increase the value of that training must above all be efforts made by individuals, and that if help were to be given its main object must be to develop personal motivations on the part of those benefiting from it.

With regard to the educators, and more generally the educational institutions, the position of the Conference has already been described. Though some might consider it paradoxical, the more such institutions endeavour to impart culture the better they will be able to adjust themselves to the requirements of the technological world. It was clear, however, from discussions at the Conference, that educators are expected to broaden the bases of a culture for people of our time. Higher

educational establishments are moreover expected to take an active part in the continuing education of personnel in employment.

Employers were perhaps the main object of criticism at the Conference and it was to them that its most urgent recommendations were directed. The forecasting of training requirements is very largely done according to specifications laid down by them, which serve as standards for the recruitment of highly qualified personnel. Optimum utilisation of this personnel depends on the provision of ladders of promotion, and this is possible only where firms have a personnel policy and the necessary machinery for implementing it. It is the task of employers or trade associations to provide specialised training for the younger members of the highly qualified personnel who can acquire only a very general training in the course of their higher education. Finally, it is also the task of employers or trade associations to take the necessary measures to provide, or at least facilitate, the continuing education of personnel in employment.

As regards the role of the government, the position necessarily varies from one country to another. According to one of the Working Parties' reports, the general feeling among participants was that the government should encourage action taken by educators and by employers, without intervening too directly. In some cases, however, a very large number of teaching establishments are under the direct control of government departments, and problems of guidance and placement are handled by the employment services. Finally, it frequently happens that only the public authorities can effectively co-ordinate the efforts of all the parties concerned.

In addition to the parties already mentioned there are the professional and trade associations and groups. The representatives of the European Federation of National Engineering Societies and of the European Association of Personnel Managers showed how such bodies could contribute to research into the training and utilisation of highly qualified personnel, and how they could speed up the development of training programmes and facilitate the continuing education of their members. Notes on the action taken by these associations and on the relations between their national sections, the university authorities and governments, have been forwarded to the Secretariat.

The need to avoid an excessive spread of responsibilities is too obvious to require detailed justification. It is clear that, until quite recently, the distribution of responsibility between ministerial departments, and the absence of sufficiently close contacts between the public and private sectors have led to parallel action that has not been sufficiently well co-ordinated. Thus, in spite of a move towards more effective co-ordination in France, the matching up of forecasts of resources with forecasts of requirements of highly qualified personnel has been only partially achieved, as is clear from the Page report.

The measures taken in the United Kingdom and in Canada to remedy this situation were discussed on the basis of the Spence report and the Canadian report. Other action at national level might have been mentioned. For example, the setting up in France of a joint working party which includes all groups interested in "occupational training and promotion" should ensure a regular confrontation of employment and training forecasts, and encourage the various authorities responsible to take the necessary measures to remedy imbalances. The Conference was of the

opinion that in each country a commission should be set up to lay down the guide lines for a concerted policy for the training and optimum utilisation of key personnel.

The large majority of participants seemed to be of the opinion that such commissions should not confine themselves to studying the special problems of highly qualified scientific and technical personnel. In the first place, whatever their initial training and the duties carried out during the first stages of their career, many highly qualified people sooner or later move on to management posts. Furthermore, better utilisation of highly qualified personnel calls for the creation of a body of technicians with middle-level qualifications. It therefore seems essential to widen the concept originally agreed for the sake of speed and convenience. Future studies should cover the training and utilisation of all senior and medium-grade executives, whether they have been trained in science and technology or economics, social science or administration.

The role of OECD

Having described the measures which must be taken at national level, participants acknowledged the need for a permanent exchange of experience and ideas between Member countries. These exchanges should cover both the progress of research, and the development of the institutional structures defined earlier.

The Conference requested OECD to draw the attention of Member countries to the recommendations set out in this volume. It also urged that the Organisation should make the necessary arrangements to pursue further the work begun in Washington and continued in Paris. One way of doing this would be to set up a working body to meet at regular intervals. In conclusion, the participants hoped that a third conference might be held in about two years time to consider the problems not yet dealt with and compare the latest achievements.

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STUDY GROUP N° 1

Chairman, Dr. W.R.Dymond, Assistant Deputy Minister, Department of Citizenship and Immigration
Chairman of Manpower and Social Affairs Committe, OECD.

Report by
C.J.Spence, Co-secretary of the Committee on Manpower Resources for Science and Technology, United Kingdom.

A. Mandate of the group

This group will study how educational authorities are informed of the labour market and evaluate future labour requirements in order to adjust the educational system and the content of courses to meet the needs for scientific and technical personnel.

B. The nature of the labour market for highly qualified manpower

We agreed that many factors at present prevent this part of the labour market from being, in the economic sense, a perfect one. Questions of status, of professionalism, and of convention on the one and, and lack of effective analysis and adequate career guidance on e other, prevent this. Basic concepts need clarification - even such portant issues as what constitutes or identifies a shortage, and how objectively to classify categories of occupations so as to avoid artificial

shortages, and to take account of desirable amounts of substitution between disciplines and levels of training.

There was general support for the view that employers are tempted to write their specifications for employment too narrowly - but this was only one of a number of factors impeding mobility between occupations. Others resulted from rigid career structures or the effects of pension schemes.

We recognised the importance of looking at the problem of highly qualified manpower in the round, both in relation to the totality of highly qualified manpower in all fields and also in relation to technical supporting manpower. No view of the graduate level was valid unless the relationship with other levels and their effective deployment was understood. Similarly there was need for close collaboration between those concerned with manpower generally and those handling the special problems of scientific and technological categories. Further understanding of the operation of this labour market at the national level could in turn lead to an understanding of the action on the international labour market popularly known as the "brain drain".

C. Nature of the response of the educational system

It was, we thought, unwise and unfair to present the problem before us as a criticism of the educational system or as its sole responsibility. Employers have a vital responsibility to define more clearly than hitherto the nature (in relation to particular utilisations) of their educational requirements. The problem involves three-way contact between employers, educationalists (including professional institutions), and government, and new developments in education particularly in relation to its later stages. Following the Bosworth report we describe as the "matching section" the measures taken jointly to span the gap between the academic product and the individual effective in industry. These include courses specifically designed to present quickly to the graduate the essential environment and outlook of competitive industry. It was considered important to avoid the danger of assuming, consciously or otherwise, that the individual exists in order to prepare solely for employment. We thought our mandate a shade harshly worded on this question. What is needed is a better understanding of the career alternatives for the individual, and of career requirements by educationalists. Properly managed this information should enhance the freedom of both.

D. The place of government or of central national organisations

Each country must of course find its own solutions and equilibrium in relation to the stage of its development. We were reminded that the developing countries brought out some of these questions in stark perspective: such countries were sometimes obliged to impose direct major

controls, including quotas for subjects and contractual obligations to work in particular fields, in order to match educational output to very basic requirements.

Most countries would not find it necessary to seek to monopolise or directly manipulate the labour market. The function of Government was rather to promote the debate between the authorities responsible, to finance the research needed, and to ensure that better levels of information existed as the basis both for career guidance and individual choice. This in turn would depend on adequate manpower surveys and statistical support.

E. The statistical basis

Even in the more advanced countries, there are limitations to the statistical basis. Perhaps these are greatest in relation to an objective and detailed occupational analysis which could be correlated with educational attainments, age-structure, sex, and effectiveness in employment. Development of such data requires maximum co-operation from employers and support from government, and involves some quite long-term research of great potential value.

We considered the difficulties inherent in any kind of forward projections of manpower statistics and the limitations of the demographic data on which they are based. Various views were expressed on the practical value of both long-term and short-term projections, and we recognised that for major adaptations of the educational system, long-term projections were needed. Much might be derived from short-term projections which took into account employers' own policies. Even those sceptical of current long-term projections felt that techniques should be developed and tested further. There was much that could be done by exploiting the short-term adaptibility of highly-qualified manpower which, provided the educational preparation was on the right lines, might be expected to be a dynamic influence and to be more flexible than less educated manpower.

F. Long-term educational implications

There was a general consensus that a wide basic education at graduate level was the best preparation for future rapid technological change. This emphasized the capacity of the individual to adapt to the rapid evolution of technology. Many countries were coming to see specialisation as the last stage of the formal educational process - to be conducted with the full participation of employers and with the expectation that subsequently in the career it would need to be converted or updated for maximum efficiency of utilisation.

G. Recommendations

1. We recognise the need for employers, Government, and educationalists jointly to face, as an issue of major importance for highly qualified manpower, the implications of the adjustment between education and employment, both immediately and in relation to the career as a whole.

2. We consider it the responsibility of Governments to ensure the environment for a progressive solution to this problem, that better information exists nationally to assist the individual in the choice of career and educationalists in achieving the "matching section" with employment - which will vary in each sector of employment.

3. There is a need for futher research on basic concepts, and in particular on the nature of occupations and of substitution between them, and on the validity and techniques of manpower surveys and projections.

4. National machinery for the consideration of this important aspect of the utilisation of highly qualified manpower should be developed, and co-operation between institutions should be strengthened in view of the significance of the problem for manpower and educational policy.

5. OECD, through its responsible committees, should continue to provide for the exchange of ideas and experience on the problem of the adaptation between education and employment of highly qualified manpower.

STUDY GROUP N° 2

Chairman, Lord Willis Jackson of Burnley, FRS,
Chairman of the Committee on Manpower Resources
for Science and Technology (United Kingdom)

Report by
G.T. Page, Secretary General,
the Engineering Institute of Canada, Canada

A. Mandate of the Group

"This Group will examine the means of achieving optimum utilisation of personnel and, in particular, the problem of in-career training as an important element of a utilisation policy".

B. General

Mr. Chairman, you and your colleagues have honoured me by your invitation to serve as Rapporteur of Study Group N° 2 at this Conference. I was glad to accept, not necessarily because I expected to make a major contribution to your deliberations, but rather because I consider the theme of the Conference to be of vital importance to the economies and people of our countries. It was obvious that our discussions were based upon the belief that highly qualified personnel, by the very nature of their calling, will always be on the frontier of human progress, doing either what has never been done before, or doing in novel and improved ways what has been done. It is apparent that man

is rapidly achieving a vastly increased ascendancy over his physical being, over his earth, and over his planetary environment. In this achievement he must deal not only with the question of unexplored space and the multiple targets in colonising the moon, but also with the constant demand arising from all the socio-economic pressures created by the rising rate of population growth, the shrinking area of our world given over to food production, the depletion of our conventional mineral and fossil-fuel resources, and the pollution of the present resources of our natural environment air, soil and water brought about by the very technological advances we are now concerned with promoting.

The foregoing considerations underline the fundamental importance of the papers and discussion presented to Study Group N° 2. It was observed that technical progress is altering substantially the work performed by highly qualified manpower. They are more concerned today with the broad planning aspects of design and the development of mathematical models, and are less concerned with detailed analysis and design calculations, a good deal of which can be left to the electronic computer. Thus while there may be underemployed personnel at the more routine end of the professional scale, there are urgent demands in the advanced levels of pure and applied science, and qualified personnel are not available to fill technical and managerial functions, nor to staff adequately the universities. An accompanying problem relates to shortages of supporting technical personnel.

C. Scope of Study Group N° 2

In considering its mandate in the light of the above facts, the Group did not concern itself with assessments of supply and demand, but rather with the way the stock of highly qualified personnel is utilised, what should be done to improve this utilisation, factors which govern its allocation and distribution, the need for and responsibilities for "in-career" education, and recommendations which should arise therefrom.

D. Utilisation

What is "optimum utilisation". There was some question of the actuel meaning of "optimum utilisation", and it was agreed that a generally acceptable definition would be useful in devising methods for its achievement. In view of the lack of clarity that was evident in discussions concerning the precise meaning of "malutilisation of educated manpower", the meeting:

> RECOMMENDS that the Secretariat of OECD prepare a report, or commission a report, that would clarify the concept of "optimum utilisation of highly qualified manpower" and suggest ways in which the presence or absence of "optimum utilisation" could be investigated in different countries.

Research. A review of methods of research on problems of utilisation led to agreement on the need for more adequate research and for internationally comparable studies. A useful start would be the international exchange of data.

Prime needs are for more data regarding:

(a) Factors which affect the growth rate and distribution of the stock of highly qualified personnel, both by area of employment and by function;

(b) Future requirements, which could, among other things, lead to changing emphasis and direction of educational investment;

(c) The identification, education and utilisation of adequate stocks of supporting technical personnel.

Management. The Group defined the following area of responsibility on the part of management:

(a) The development of attitudes and organisational concepts which will lead to organisational structures and conditions under which highly qualified personnel can themselves develop toward optimum utilisation and adequate opportunities for career growth. A climate of creativity and productivity is essential;

(b) The use of appropriate recruitment policies, with the levels of the skills recruited being related to the actual skill needs of the enterprise;

(c) The recognition that management must attach as much importance to its own manpower policies as it now does to its economic and fiscal problems;

(d) The awareness that managements' attitude to innovation has a direct relationship to the effectiveness of the utilisation of highly qualified personnel, in the same way as does the relation of a given industry to its market;

(e) The awareness that there may well be significant relationships between the retention of highly qualified personnel and utilisation.

Management and education. It was considered essential that there be much more institutionalised liaison and communication between education and management in curriculum design; this could include a careful review of the criteria of the systems of formal education vis-à-vis the practical requirements of professional life now and in the future, and could lead to a better relationship between the needs for skills and basic education, rather than relate education to narrow job titles and specialities, both of which are restrictive and transitory. For example, considerable progress has been made in this direction in Sweden, and other by-product benefits of this formal relationship include a much better utilisation of highly qualified personnel in industrial research and development.

Professional organisations. It was agreed that professional organisations must become involved in the establishment of ideals and criteria for professional education and utilisation, and the related problems of the identification, education and utilisation of technical personnel in the proper numbers for each skill area.

E. Continuing education

The Group discussed the continuing education of highly qualified personnel, and gave considerable and detailed attention to the continuing education of engineers, for which the generally accepted name is "Continuing Engineering Studies".

The needs for continuing education cover the following range:

(a) Adapting the new supply of highly qualified personnel to the responsibilities of employment (e.g. Centre of Productivity in the United Kingdom);

(b) Adding related special technical skills;

(c) Up-dating basic technical education;

(d) Adding other essential knowledge as the career develops, e.g. management, economics, etc.;

(e) The professional training and the development of professional attitudes on the part of highly qualified personnel.

The objectives of continuing education appear to be:

(a) Improved utilisation as specialists;

(b) More flexible long-term utilisation;

(c) The teaching of new mental functions not taught in university, such as the making of choices and decisions.

The impact of changing technology on continuing education was recognised, and it was considered essential that management must identify among its highly skilled manpower those who offer promise for technological extension, and give them full scope and assistance in developing and applying their personal competence.

Location of and responsibility for continuing education. There is a difference in approach to this problem between large industries and the medium and small industries.

In large industries, continuing education tends to be centred within the industry itself, particularly because most of the skills required are found in industry and because the problems of staffing and finance may be more easily resolved, either within the industry or by direct relations with universities.

Among small and medium industries there is a need for inter-industry co-operation, along with that of universities, governments, professional organisations and industrial organisations in resolving the problems of staff, finance and the allowance of time off for studies. It was noted that there may be national differences in the way these groups organise and operate to provide continuing education.

The meeting stressed the need for the maximum effective utilisation of existing and, usually expensive, training facilities when considering the location of and responsibility for continuing education.

Important specific items brought forward by the Group included:

(a) The need for emphasis on the function of synthesis, e.g. design, in the continuing education programmes;

(b) Studies are required on the problems of staffing and methodology for continuing education;

(c) The need for management to adopt a constructive attitude vis-à-vis the continuing education of its highly qualified personnel;

(d) The need for the continuing education of management in the awareness and use of new skills and new tools available for management decision making;

(e) The need for the continuing education of highly qualified personnel in universities and government;

(f) The need for the continuing motivation of educators to keep up to date both technically and vis-à-vis related industry, since education is somewhat out of phase with present and future basic skill needs of industry;

(g) The need for studies, recognising particularly the potential of the "late starter", to facilitate his access to undergraduate and graduate studies;

(h) The need for the support of much more applied research at universities, not only for its own intrinsic value but also as a basis for discussion and liaison between universities and industry;

(i) The need for the international exchange of information, programmes, studies, etc., particularly those which concern pioneering work in this area;

(j) The desirability of studying the recommendations of the 1966 EUSEC Conference on Continuing Education Studies, and EUSEC - OECD reports on the education and training of engineers, when considering the problem of continuing education;

(k) The need for the extension of labour permits for those highly qualified personnel who must sometimes have extended international experience.

F. Utilisation and continuing education

The Group stressed the importance of employers undertaking continuing education. They must become aware that appropriate early counselling, orientation and motivation and the subsequent needs for continuing education are essential to ensure the maximum effective utilisation of highly qualified manpower.

What we need now are concrete programmes of action and much more specific definitions of the problems and of suggested solutions. Employers must ensure that new technologies are exploited to the best

possible advantage, but must also develop adequate policies for the recruitment, employment and training which will assist highly qualified manpower to accept and participate in whatever changes are required. Only the careful maintenance of balance between these two objectives will ensure that the services of this important segment of our manpower are fully utilised under conditions of continuing rapid change.

G. Human values

With the permission of the Group, your Rapporteur suggests that technological "know-how" cannot be divorced from the scientific and philosophic exploration of "what is". The harmonizing of technology with man's enduring spiritual, social and political needs must be done, not sometime in the future when we have more time to think about it, but as we go along. Creative thought must be given now to ensure that all the factors of our scientific and industrial progress continue to sustain the overall objectives of a strong economy, a high standard of living, and the prevention or relief of all forms of human suffering. We must view these factors with a deeper understanding of the meaning and purpose of the goals towards which we aspire as members of the entire human family.

H. Concluding recommendation

The above ideals and the specific items considered important in the detailed considerations of the Group in its attack on the problems of utilisation and continuing education, may appear to be high-sounding, but are perfectly genuine.

But, in devising ways to work toward their achievement, as well as referring all of the foregoing considerations to OECD and its Member countries for serious attention, we must ensure that there exists an efficient international and national machinery to lead, guide and even to push us along avenues of constructive and well-considered action.

The Group therefore:

RECOMMENDS that OECD play an active role for future action in the utilisation and continuing education of highly qualified personnel by acting as a centre for the exchange of information and experience, by stimulating and assisting in the design of internationally comparable research, in studies of methodology and innovations, and in stimulating the creation of national bodies to carry forward this important work where there is none at present.

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CONCLUSIONS AND RECOMMENDATIONS

The Conference has reaffirmed the view that the economic expansion of Member countries, which is the central concern of OECD, can be greatly facilitated through policies deliberately designed fully to develop and use the human resources of participating countries.

It has also underlined the crucial role which the educational system, in its wider manifestations, should play not merely as a supplier of qualified personnel but also in the effective utilisation of such personnel on a continuing basis. This calls for a more explicit recognition of the need for interaction between the demands of employment and the development of the educational system. In the context of the rapid development of science and technology where the nature of occupations and the corresponding knowledge are constantly changing, it falls to education and training to prepare individuals to respond to the constantly changing functions which they will be called upon to perform during their whole active life.

The Conference has concluded that there is an urgent need for a definition of appropriate policies for training and utilisating qualified personnel which can be formulated only on the basis of the results of relevant research and experimentation and the setting up of appropriate institutional administrative arrangements.

I. Definition of policy

The Conference has first defined the range of questions which are covered by a coherent policy for the education and utilisation of qualified personnel.

On the one hand, consideration of the demands made upon the educational system leads to the conclusion that in order to fulfil its economic as well as its cultural role this system should be developed further

in several respects, and in particular that it must make provision for the in-career training of a large section of the active population.

On the other hand, the full utilisation of personnel is based on the assumption that people are distributed rationally between the various activities, that full use is made of the available educated personnel, especially women, and that, at each stage of the career, the job corresponds to the capabilities of the worker. Full utilisation also depends on continuous training, since technological development may render educated staff redundant if their knowledge becomes obsolescent.

II. The necessary research

The determination of the content of the policy problems outlined above implies extensive research into the actual situation and the available alternatives to reach rational decisions on the measures which have to be taken.

The range of policy problems can be separated into five main areas of research.

(i) The improvement of the information system

As a general condition for the determination of policy it is necessary to have a complete system for making available to the decision-making bodies in each country the information needed to shape national policies. This could be greatly improved by the following measures:

- The development of standardised statistics appropriate to the requirements of the educational and employment authorities, and designed to encourage a dialogue between them;
- The preparation of a new classification of occupations based on educational criteria, covering both the level and the type of education;
- The acquisition by employers of more complete information for their own use in devising better methods of utilisation as well as to enable them to advise public authorities in the field of education and labour on the basis of precise data;
- An inventory of all the available means of professional training in each country, public and private.

In addition, the methods of forecasting manpower requirements might well be made more reliable by studying, among other things:

- The possible substitution between different types of personnel for the production of similar goods and services;
- The changes of occupations resulting from technological progress;
- The development of the tertiary sector.

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(ii) <u>The modification of the structure of the educational system and the development of educational programmes to meet the requirements of employment.</u>

Research is required into the relationship between educational experience and attainment and the demands of employment. The following research might be carried out:

- The steps necessary to ensure adaptation of recruits from the educational system to the requirements of first responsible appointment.
- The formulation of systems of in-career training applicable to highly qualified personnel whatever the size of their employing organisation.
- Appropriate training methods for professionally experienced adults.

(iii) <u>The orientation of young people during their studies</u>

An understanding of the factors affecting the orientation of the rising generations is necessary in determining a policy for the improved utilisation of human resources. This should take into account not only the wider functions of education but also the nature and importance of job opportunities, personal aspirations and previous school performance.

For example, studies might be undertaken on:

- student motives in choosing between different courses;
- the kind of information which is likely to identify or awake interest in science and technology;
- the role played by the organisation of primary and secondary education in determining the vocation and orientation of young people;
- the school and university career of each adolescent in order to discover the kind of aid and advice which is necessary to ensure a better utilisation of individual aptitudes;
- the use of transitional phases between education and employment.

(iv) <u>The distribution of graduates between the various branches of activity</u>

The subsequent distribution of graduates between activities is a further element in the utilisation problem. Studies might cover:

- the individual's motives which influence his choice of initial employment;
- the way in which graduates are subdivided between the different branches of science and technology at the end of their studies;
- the role played by employment services in the decisions of employers and individuals;
- the determinants of participation in employment (the activity rate) among graduates, particularly women, and the causes of existing unemployment among them.

(v) The careers followed by individuals during their active life

In order to reveal the dynamic aspects of the relationship between the individual and his employment, studies might be carried out covering:

- the actual evolution of careers of highly qualified personnel and the supporting staff needed at each stage to ensure the best utilisation of their qualifications;
- the needs for in-career training at each stage of professional life and the necessary means to fulfil them;
- mobility both within employing organisations and in the economy as a whole, and the review by governments of the problems involved in the possible intervention in the labour market to promote the changes of occupation or firm which might lead to an improved utilisation of the aptitudes of each individual during his career;
- the career policies of certain firms and the effects of the firm's organisational structure on the full development of individual ability;
- value of scientific education for non-vocational participation in life.

III. Institutional arrangements

The main function of the institutional arrangements necessary for the determination of an integrated policy is one of co-ordination and stimulation. It is evident that policy-making involves the jurisdiction and interest of several distinct authorities and bodies under all the ministries concerned with the nation's human resources, and it is desirable that their representatives should agree on the general lines of policy. They should also be active in promoting the necessary research.

At the international level there is a similar need for co-ordination and exchange so that participating countries can benefit from each other's work.

RECOMMENDATIONS

The following recommendations have been made corresponding to the requirements described above. The first proposes that policy problems be considered as a whole while the second and third relate to the appropriate institutional arrangements and the carrying out of the necessary research.

Recommendation I: definition of policy

Member countries are invited to develop a systematic policy for the education, training and utilisation of highly qualified personnel appropriate

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to the needs of their economies within the context of educational and manpower policy as a whole. More precisely this policy would have the following aims:

- to integrate into a coherent whole, school and university education and the necessary complementary training for each individual during his economically active life;
- to assure the provision of suitable information for the guidance of students during their studies;
- to assure the development by the employment services of a complete information system for facilitating the optimum utilisation of the highly qualified labour force.

Recommendation II: institutional arrangements

Member countries are invited to initiate appropriate national machinery whereby representatives of public authorities responsible for education and manpower, employers' organisations and professional associations may co-operate together in order to assist in preparing the general lines of a concerted policy for the supply of highly qualified personnel. They will have to define, promote or direct the studies and research necessary to make available to the decision-making bodies the information required to determine their policies and to propose practical means of realising the in-career education of highly qualified personnel.

Recommendation III: scope for international action

The participants recognise that there is a continuing need for exchange between countries of research methods and results as well as for a confrontation of policy developments. To this end they wish to invite the OECD to bring the recommendations of the Conference to the attention of Member Governments and to provide the necessary continuing arrangements to keep under review relevant work in Member countries and to encourage and promote comparative studies.

Recommendation IV: next conference

The participants invite the OECD to organise a new conference before the autumn of 1968, to review .e work accomplished in the meantime in the Member countries, and to identify new needs and the future work to be done in this field.

II

EXTRACTS FROM OR SUMMARIES OF THE PRINCIPAL REPORTS PRESENTED

A. BALANCE BETWEEN NEEDS FOR AND RESOURCES OF SCIENTIFIC AND TECHNICAL PERSONNEL

ADAPTATION OF THE SUPPLY OF SCIENTIFIC AND TECHNICAL PERSONNEL TO THE NEEDS OF THE ECONOMY: FRENCH EXPERIENCE AND POSSIBLE IMPROVEMENTS TO THE INFORMATION PROCESS

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Introduction:
Economy, Employment, Education

The problem of equating yields from the educational system to the needs of the economy is one which in the first analysis falls under the heading of employment policy. While it is true that failure to equate these yields is reflected in imbalances which occur at some given moment on the labour market, every case of market imbalance does not however necessarily point to such a shortcoming.

Labour considerations were a major aspect of cyclical events during the thirties, in the face of widespread and continuing unemployment. In analytical studies stress was then primarily placed on the economic variables determining the creation of employment opportunities. Such a general theory of economic activity emerged as that of KEYNES, which tends to favour effective demand, i.e. the two economic variables of consumption and investment. Economic policy, under the impact of employment considerations, was less concerned with the unbalanced state

of the labour market (do we not hear of balanced under-employment?) than with the level of employment as a whole

Once ideas had started to flow along these theoretical lines, however, the logical extension of such a movement of thought in conjunction with the radically different trends underlying post-war development, was the introduction, alongside the economic variables, of a "human variable". Since one of the objectives of economic policy was "full employment", first the precise content of this concept consequently had to be defined. The concept of full employment necessarily went beyond that of "full utilisation", that is, an opportunaty for any willing and able person to work, and was gradually superseded by the notion of full "economic" employment, where the aim is to provide such employment opportunities that, allowing for individual capabilities, each person makes the utmost contribution to the overall product. Secondly, with the general trend from underemployment and stagnation progressing towards actual (or social and political agitation for) full employment and sustained expansion, the emphasis came to be placed on capacity of the factors of production. While the productivity of manpower taken in its broadest sense certainly depends on the means placed at its disposal (energy, material facilities, organisation, etc.) it also hinges on the ability of individuals to use them to best advantage, which in turn will largely be determined by the training they have received. This being so, the aim of employment policy will not only be to provide employment opportunities, but to match job opportunities with the economic agents. To the purely quantitative factor of numbers of vacancies will be added a qualitative factor which is the matching of individuals to jobs and jobs to individuals.

While the level of employment remains one of the leading concerns of general economic policy, one of the specific objectives of employment policy is to mitigate or eliminate imbalances appearing on the labour market. When examined from the standpoint of education, these imbalances call for comments on two counts:

Imbalances on the labour market and education

In the first place, not every imbalanced employment situation can be attributed to the training of individuals. Loss of equilibrium comes about as a result of poor adjustment of the labour supply to the demand. Lack of adaptation is both quantitative and qualitative. It can be purely quantitative in certain extreme cases, but these will seldom occur in practice. Sometimes the total number of vacancies is less than the total number of individuals able and willing to work (underemployment, hence unemployment), or the situation may sometimes be reversed (over-employment, with a consequent general shortage of labour). A purely quantitative imbalance occurs only if the relationship at overall level is the same for each category of workers. In other words, a surplus of manpower in certain categories must not be accompanied by a shortage in others. Should this however occur, as it is most often apt to do, disequilibrium can be said to be quantitative owing to its qualitative nature. Here, however, factors other than training may be to blame. It must be remembered that socio-economic factors sometimes prevent the desired

adaptation of available manpower resources to cyclical variations in employment or even to changes over the longer term occurring in some sector. This behaviour illustrates the shortcomings of the labour market. Adaptation can thus be delayed or arrested by a wage structure offering inadequate financial incentives, by a reluctance on the part of workers to transfer to activities elsewhere and by working conditions or jobs of a type to deter applicants actually capable of filling available posts.

Other quantitative imbalances which are qualitative in origin can instead be attributed to the type of education received by individuals. In this case the subject for concern is the occupational structure of the active population. This can be broken down into the major sectors of agriculture, industry and services, and by branches of activity. These branches can in turn be subdivided according to nature of occupation, and each occupation moreover be broken down by level of skill. Thus, to use the accepted terminology, employment can become unbalanced if manpower supply and demand are unadjusted according to occupation and level of skill. If it is agreed that the occupation to which a person belongs and for which he is qualified depends on his training, it can be argued that the yield from the educational system cannot be equated with the requirements of the economy. A similar lack can also occur in situations where failure of adjustment between manpower supply and demand is latent. This subject will later be reverted to, since these are situations where more ample information would be extremely useful. Suffice it to say here that cases of this kind arise when the supply balances the demand, but under such explicit or implicit conditions that equilibrium is provided in some jobs by over-skilled, under-skilled, or wrongly skilled personnel.

Only those imbalances that can be ascribed to education will henceforth be considered. The scope of the analysis will moreover be limited to two counts - one having to do with the type of education, since only scientific and technical personnel will be considered, and the other being the level of education applicable to the technical, engineering and executive grades (1). The category of manpower thus defined is interesting in more ways than one. It plays a strategic role in the economic growth of the industrially developing or already developed countries, owing to

(1) In general terms this twofold distinction normally embraces personnel from post-secondary and higher education. In the context of present French educational reforms, these two categories constitute what are known as "fields of higher education". These mainly include the Facultics, the "Grandes Ecoles" and the university institutes of technology. These last - some are to begin their activities in the 1966-67 academic year - are designed "to train senior executive and technical grades for industry and the tertiary sector who will be responsible for the practical application of abstract concepts or the results of theoretical research. They must have received a more thorough and more detailed technical training than that of engineers, and their outlook must if possible be broader thant that of the ordinary technical grades", (Ministry of Education "La Réforme de l'Enseignement", Paris, 1966, page 7).

the major impact technical innovations and their practical application are bound to exert on modern economies.

This type of personnel is also noteworthy in view of its increasingly important place in the active population. Not only is it in the forefront of production, but it plays a key role in research, the discovery of new products and production methods, the scientific organisation of activities, and market forecasting.

All these considerations combine to give scientific and technical personnel importance on a third count in that it renews or increases its numbers and adds to its knowledge by means of education. [illegible] and particularly significant feature marking this type of personnel [illegible] the standpoint of equating education to economic requirements - is [illegible] extra period of specialised training they need to reach the topmost ranks of the hierarchy.

Respective horizons of employment and training policy

A determination of the time needed for education brings up a second set of considerations. We saw that employment policy was concerned with imbalances in general, of which but a few bore any relation to problems of education. The lack of adjustment between labour supply and demand as considered in terms of time under employment policy should now be examined.

Employment policy is, in essence, a cyclical policy, that is to say that it considers imbalances existing at some specific time and endeavours to deal with them at short range. Whenever these imbalances can be attributed to educational patterns employment policy can do no more than take note, as far as manpower is concerned, of a need for adaptation that may have existed for several years. Action to restore the balance may accordingly either be exerted on the economic variables promoting employment opportunities or on the human variable determining the supply of appropriately qualified personnel. In the first case, rarely can any significant effect be achieved before 18 to 24 months, as can be seen from the efforts to decentralise and to introduce new industries as part of regional development policy. In the second case the need to adapt workers to new jobs becomes apparent. Such changes are likely to be easiest when the level of training is high (the executive grades, up to a certain age, have a greater capacity for self-adjustment), but there are limits which are difficult to exceed. These become readily apparent whenever an attempt is made to go beyond a skill - taken in the broad sense - that has been acquired, since not only does it imply special basic knowledge (e.g. mathematical training) but an individual mental approach, and after a certain amount of experience in the occupation, a particular pattern of behaviour in relation to the working environment. Conversely, the lower the initial level of training, the greater the likelihood that specific "re-training" activities will effectively promote occupational mobility.

The type of action needed to adapt the labour supply to the demand in terms of occupational capacity has compelled employment policy to look beyond purely cyclical aspects. Since factors of inadap[illegible] were

apt to be latent several years before actual imbalances appeared, the proper step was to prevent their occurrence, instead of simply taking remedial action to dampen their effects. Hence the use of long-range forecasts to anticipate possible imbalances in job vacancies and job specifications as related to manpower resources and levels and types of skills, and so influence both groups of variables. The aim is to ensure that they each evolve in such a way as to further the objective of balanced growth. The general procedure used in such an approach - sometimes described as "regulation" - is largely structural in character. Defining the conditions in which the future supply of skilled manpower can be adadpted to meet economic demands amounts to defining the structure of manpower in terms of training and that of jobs in terms of needed skills in such a way that both are mutually compatible.

The question is whether employment policy is equipped to deal with these matters. To begin with, the change from a cyclical to a structural approach, and from short-term corrective action to a longer-term target forecasting process undoubtedly constitutes an innovation. Under French planning procedure the existence of a Manpower Committee, a horizontal body which from the manpower standpoint co-ordinates the objectives of the various vertical committees (by branch of activity) is indicative of this change of perspective. The question is whether the economic horizon covered by a four-year plan provides sufficient scope for a training policy, particularly the training of highly qualified scientific and technical personnel.

Admittedly the four-year plan is being brought increasingly into line with longer-term prospects, but these can hardly do more than indicate very general aggregate trends. Some of the comments in the conclusion of the General Report by the Investment Commission for Schools, Universities and Sport under the Fifth plan are of particular significance in this respect. The report points out that the Commission's task is to prepare an investment and not a national education programme. It is true that when estimating infrastructural needs the Commission cannot fail to examine problems on whose solution the investment effort must depend. Since the infrastructure must meet the needs of education programmes training policy will inevitably be touched upon at the same time. The Commission's recommendations, however, are not all of equal value. "Dealing as they do with equipment, they are based on decisions already taken by the authorities, since the amount of investment in infrastructure for schools, universities and sport is fixed in a document approved by Parliament: as a result they carry an undoubted element of compulsion".

On the other hand, in the case of measures of particular importance in training policy, such as determination of the distribution desired for the school and university population, the Investment Commission's recommendations constitute "no more than a proposal". Above all, the Commission considers that if it were to be given the task of outlining a genuine national education plan, planning techniques would have to place far greater emphasis on long-range forecasting. It feels that "in matters of education the target of present plans is set much too close and general objectives to be achieved in the next twenty years should constitute the necessary framework for the formulation of shorter-term plans".

How can forecasts be justified over such a long term? Generally speaking, by what it has been proposed should be called the inertia of the educational system, which is "the time elapsing between a decision

taken on the training of young people and the effects it may have on economic life" (1). Inertia, it would appear, results from the compounding of two intervals: the time taken by the educational system itself to react, and the turnoff into specialised training. The first is the period required for adjustment by the educational system when it seeks to modify the quantity and quality of its output not only by erecting new buildings and training teachers but by restructuring the educational system. (Thus the report by the School Investment Commission noted that the extension of compulsory schooling, decided in 1959, could not actually be put into effect under normal teaching conditions before 1972 at the earliest).

The branching off into specialised training refers to a training period outside the main stream in such a direction that access to several channels of training in theory is still permitted while the rejection of various alternative channels is implied. (For example, under the educational reforms at present being introduced in France, the end of the first cycle of the general secondary course may to some extent be regarded as the starting point of specialised training).

Thus although forecasting plays an increasingly important part in the formation of employment policy, the horizon does not appear to match that of training policy for scientific and technical personnel. This raises a further point. Should the equation of yields from the educational system to the needs of the economy be a one-way or two-way process? Theoretical analysis tends to show that in the long run both the demand for highly skilled personnel and the supply interact (2). This means that future manpower needs or employment opportunities offered by the economy will depend in part on the training policy pursued.

In the first place, the present supply of highly skilled personnel partly determines the pattern and rate of future economic expansion, which at the same time is influenced by training programmes to the extent that they divert material, financial and human resources from immediately productive employment. Economic objectives are hence in some measure sub-ordinate to training objectives. Equating the resources yielded by the educational system to the needs of the economy would, strictly speaking, call for the reciprocal adjustment of the economic variables and the human variable (3). Economic development plans and manpower training plans would thus be regarded as interdependant variables. The present state of knowledge and information makes it very difficult to use such a method of adjustment. In practice, therefore, even where an attempt is made to take future quantitative and qualitative aspects of the labour-force into account when forecasting economic needs (or in more selective planning, when settling upon economic objectives) the main tendency will be to adapt educational plans to such future economic needs.

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(1) "La planification de l'enseignement en France". In "Notes et Etudes Documentaires", n° 2935, 9th November, 1962, page 3.

(2) See P. Paukert "L'interdépendance de la planification relative à la main-d'oeuvre hautement qualifiée et de la planification économique". In "Revue internationale du Travail", April 1964, pp. 380 to 396.

(3) "In other words, the overall demand for highly skilled manpower and the demand pattern will depend, among other things, on the investment decisions taken while these in turn will be influenced by the supply of highly skilled manpower". F. Paukert, op. cit., p. 391.

At this stage of the argument we may sum up as follows:

- Equating resources yielded by the educational system to economic needs is primarily a matter for employment policy, since it is need which arises with the appearance of imbalances on the labour market;
- To deal with this kind of imbalance employment policy should no longer be concerned exclusively with cyclical considerations, but with longer-term predictions of future job patterns according to th. levels and types of skill workers will require;
- Employment policy must therefore take account of training policy, but training targets usually lie beyond the effective range of forecasts of manpower requirement conducted for the purposes of employment policy.

The question then is whether the economic horizon and the aims of employment policy and training policy can be made to coincide - or at least converge. Can any sort of common language and common objectives be found? Not only does this raise problems of co-ordination and co-operation, but perhaps to an even greater extent the question of available information.

The intention here is to examine such matters mainly in the context of planning as conducted in France, in which long-term policy both as to employment and training is broadly plotted. Following the same line of thought as in these introductory pages, an attempt will be made to ascertain how and to what extent the two questions overlap. Part I will describe the relationship between forecasts of manpower requirements and training programmes, while Part II will propose to show, with reference to particular problems, how the data might be improved so that training may be better adjusted to future economic needs.

The writer has no more ambitious goal than that of synthesis and reflection. Although he has for several years been concerned with the economic aspects of manpower training, he neither regards himself as a specialist in educational planning nor has he played any direct part in the research and forecasting activities of the working parties preparing the plan. French specialists on the subject cannot therefore expect to find any fresh or original ideas in these pages, although they may have reason for contesting or challenging certain impressions and conclusions which can be put down to the author's inadequate information or lack of experience.

I. Forecasts of Manpower Needs and Training Programmes as Part of Current Planning in France

Without attempting any systematic, detailed review of developments, the subject may be presented on roughly the following lines. Forecasting was undertaken in order to fix targets for the purp[illegible] of employment policy on the one hand, and for the equipment of schools and universities - hence for training policy - on the other. At first the two processes were probably quite separate. Only in the recent past has an effort been made to direct them towards a common objective, and more specifically, to adapt training policy to the needs of the economy. For reasons connected with the nature of the problems under consideration and the inadequacy of the information available, as things now stand presumably convergence can only gradually and partielly be achieved.

There are therefore three successive points of interest. Before considering them it may be well to state our basic premise. The subject of forecasting and policy-making has been mentioned. A policy is the implementation of a plan. It defines objectives and the means of attaining them: these means may be known in greater or less detail, but we must be reasonably sure that they will be available if the objectives are to be realistic. Whether they are in fact realistic will however also depend on the forecasts, the usual basis for the objectives. This is particularly true of planning as it is carried out in France, where objectives ultimately have no more than an indicative value. A distinction may therefore be made between forecasting and planning from the conceptual aspect, while in practice they are interdependent (1). Forecasting and planning, though not identical, will accordingly be regarded as closely related.

A. Employment forecasts

The work of the Manpower Committee is divided among three subcommittees whose distinct functions are apparent from their titles - "overall employment balance", "trends in skills and trades", "regional employment balance" - making three separate approaches which logically follow each other in the order mentioned (the subcommittees incidentally being numbered in the same order). We need but mention the essential features of the first subcommittee's duties, which normally determine those of the second. By enabling manpower needs to be estimated according to skills,

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(1) In forecasting, independent parameters are determined according to the expected behaviour of individuals and of public bodies. In planning, the value of certain parameters can be regarded as an objective to be attained. The planner must however allow for forecasts relating to factors which have no value as objectives, and the forecaster for factors which do, that is, by allowing in the forecast for both "spontaneous" and "programmed" responses under a policy.

the second intervenes at a stage of analysis at which transposition is possible in terms of training requirements. Its work is therefore directly relevant to this report. The task of the third subcommittee largely consists in a regional breakdown of estimates by the first two. In any analysis of methods designed to further the adaptation of training to the needs of the economy, its activities are essential. For not only must vacancies and corresponding skills be forecast, but their location be determined in order to decide where training establisments should be set up. This is because the geographic mobility of labour is limited, although that of highly qualified scientific and technical personnel is admittedly greater, particularly at the outset of their career. In spite of these considerations, the "regionalisation" aspect of the problem will not here further be dealt with. In the first place it is a highly important specific subject which deserves to be analysed by itself. In the second place present circumstances in France allow no regional figures to be compiled in regard to the balance of employment skills. No useful purpose would therefore be served by approaching the problem of skills from this angle.

1. Overall balance of employment

Forecasts of overall balance are obtained by comparing total manpower requirements with total resources.

Manpower requirements

These are assessed by calculating the number of vacancies that will be offered by the different branches of the economy if they maintain the rates of growth provided for in the plan. Three main sectors are considered. In agriculture, forecasts are particularly difficult both because little is known of the structure of the agricultural population and because "numbers are not likely to fall by 1970 to the level required from the strictly technical standpoint". The subcommittee has therefore considered "what reductions in the agricultural population and consequent transfers to other sectors are possible as determined by the relevant population's present structure".

In the industrial sector anlysis can be taken much further. It is based on production forecasts by branch at the end of the plan, and on the expected growth rate of productivity, an input-output table being used to ensure consistency of the forecasts. Once estimates have been made of production and productivity, numbers employed at the end of the plan are forecast by allowing for the reduction in the working week, the determination and the economic and social effects of which were studied in a special report prepared for the Fifth Plan. Provision for such a shorter working week, along lines meeting demands by trade-union organisations, was made in the Act approving the Fifth Plan. It was considered that an average reduction of one and a half hours between 1962 and 1970 was compatible with the objectives of the Plan. It is relevant to the present report to note that a knowledge of quantative manpower requirements is obtained from forecasts which have the value of objectives relating to production, productivity and hours of work. The forecasts themselves are based on an examination of past trends and on analyses by each vertical committee of manpower requirements in the corresponding branch of activity.

It is in the tertiary sector that the largest number of persons are employed: 43 per cent of the active population in 1965. It is also the sector in which employment is likely to expand the most throughout the Fifth Plan (9.5 per cent). There is, as we know, a propensity to lump under the "tertiary sector" a number of service activities of a largely varying nature where development prospects and the amount of technical knowledge required of job-holders are concerned. Employment estimates hence differ according to whether transport and commercial activities or a composite whole combining services, administrative department and financial institutions are considered. The report by the first subcommittee notes that "the Plan's modernisation committees are not yet equipped to cover more than a certain proportion of activities in the tertiary sector: only those forecasts concerning health, education and certain services (advertising) can be based on the committees' work". The extreme diversity of activities in the tertiary sector, and the inadequacy of statistical information render the use of a single method of forecasting impossible. Unquestionably, it is more difficult to observe and interpret past developments in most branches of the tertiary sector than in industry. Nor is there any doubt that the production and productivity concepts and the assessment of actual trends underlying such concepts raise many problems. The tertiary sector, which in developed societies is the principal user of manpower, hence does not easily lend itself to forecasting. Yet certain branches of this sector are apt to provide some of the newest openings for highly qualified scientific and technical personnel. Cases in point are the modern management methods (and computers, the scientific tools of management) introduced into government or private administration, and the very considerable increase in tasks of a scientific and technical character in such service activities as the armed forces. It may also be noted that non-farm services are expected to show the greatest increase in numbers (65 per cent from 1962 to 1970). These include, for example, such major consumers of "grey matter" and technical knowledge as research and engineering consultant firms, which have considerably expanded since 1945.

On the whole the tertiary sector, particularly in certain branches, is one where any extrapolation, however heavily corrected, of past trends is unlikely to result in a satisfactory prediction. Without dwelling any further on the general questions outlined above, the tertiary sector may be regarded as aptly illustrating the difficulty of matching training to the economy's requirements. The prevailing impression is that in various new or rapidly developing activities the demand for trained personnel will continue to exceed the supply for some time to come.

Manpower resources

Forecasts of manpower resources essentially consist of aggregate estimates, and a fairly considerable element of uncertainty moreover attaches to them.

It is sufficient to recall here that the initial basis for such forecasts consists of demographic projections. These make use of natural population movements, allowing for net emigration. To compute the active population, two main groups of factors intervene for the corresponding age groups:

(i) Longer school attendance, which delays the entry of younger generations into the active population. This will first depend on the length of compulsory schooling. This institutional factor normally should be known with certainty beforehand, but as yet is undefined, since it is not known just when schooling in France will be made compulsory up to the age of sixteen. True, highly skilled scientific and technical personnel is recruited from the cohorts which pursue their studies after this compulsory period. But so far as the spontaneously increased school attendance is concerned, it must be admitted that little information is available in regard to the factors which determine relevant collective behaviour. We know of course that the tendency is towards a spontaneous increase in the length of education, but the rate and extent of the process cannot be predicted with any great accuracy.

(ii) Activity ratios, in which the availability of female or older workers is primarily affected, labour specialists encounter a great deal of trouble in computing the active population owing to the presence of what they know as marginal workers (1). No such obstacle however appears to arise in the case of personnel of the type considered in this report. The same difficulty obtains when activity ratios of women are considered. These (like those relating to older people) are particularly sensitive to cyclical variations, whence the difficulty of deducing general trends if past key observations fail to match later cyclical conditions. Permanent changes in working conditions together with social services and benefits provided for working women may also have a marked influence on the pattern of the prediction. Presumably, however, variations in the activity ratio of women can be more easily forecast for highly qualified scientific and technical personnel, and the 1962 census in fact shows that the higher the level of instruction, the higher the activity ratios for women and the more sustained the activity pattern between the ages of 25 and 40. Thus, while the activity ratio of non-graduate women remains in the region of 37 per cent between the ages of 25 and 64, the corresponding levels for female graduates gradually fall from 80 to 60 per cent.

In the aggregate, the work of the first manpower subcommittee results in the establishment of comparative estimates of manpower resources and requirements. Here again, the forecast becomes the objective. An anticipated surplus of manpower will lead to an upward revision of production targets to ensure full employment. Conversely, if

(1) Those pe[illegible], in the course of employment surveys, did not answer th[illegible] question "What is your occupation?" but stated that they had worked for at least one hour during the reference week.

manpower resources seem inadequate, production targets will have to be reduced accordingly. Without unduly insisting on the uncertain nature of this balance sheet, it should however be remembered that it is primarily designed to show the overall picture. Manpower resources appear in the form of a stock (the active population), where anticipated variations result from the play of inward and outward flows mainly in relation to age and sex. But within this stock no distinction is made as to nature of occupation or level of skill. Manpower requirements are broken down only by branch of activity. The essential framework is however provided for the second stage, which is just this forecasting of manpower needs by occupation and level of skill (1). This is the task of the Second "Skills and Trades" subcommittee.

2. Manpower requirements by occupation

The active population is distributed among different individual occupations, and can therefore be defined in terms of a certain occupational structure. This structure must be known if the intention then is to forecast the future structure by identifying likely modifying factors.

The structure of employment by occupation

Knowledge of this factor is the necessary starting point, but a twofold difficulty is the definition and nomenclature of occupations, and access to statistical data based on this nomenclature.

Every person with a job is engaged in an occupation. The term "profession" (occupation) ("métier" is generally used only to describe manual work) considered from the manpower standpoint defines, as it were, the combined characteristics of the job and the person engaged in its performance. According to the report of the Second Subcommittee, however, no satisfactory nomenclature of occupations at present exists which "sums up all aspects of the specific qualification: the nature of tasks carried out by persons employed in a given job, or the level of knowledge required for a given occupation".

The nomenclature used includes 391 items (2). "It lists occupations requiring various levels of training under the same designation; it covers manual trades in considerable detail and includes only a few posts of a technical kind". Yet it is the most detailed nomenclature for which statistical information is available, hence the handiest one for forecasting purposes.

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(1) Hence the propensity to define the occupational skill or occupation itself by reference to the relevant branch of activity, since this is the context in which employment prospects will be determined. A certain method of defining skills or occupations may therefore be unduly used.

(2) Hence far less detailed than the International Standard Classification of Occupations (ISCO) including over 1,300 occupations drawn up in 1958 by the International Labour Office. It is true that these call for considerable rearrangement when used in forecasting, as can be seen from the studies carried out in connection with the OECD Mediterranean Regional Project.

To facilitate such forecasts, a new classification consisting of 105 posts was prepared by the Institut National des Etudes Démographiques (INED). In this simplified nomenclature, the occupations in which highly qualified scientific and technical personnel are normally employed is not broken down to any great extent, and appears to favour certain occupations and relevant types of training from the users' point of view. We will revert to this point in Part II when describing the detailed list of these occupations.

Within the framework of this simplified nomenclature the basic statistical data are provided mainly by demographic surveys (1954 and 1962). These show the occupational breakdown of the active population by grouping the main economic activities under 41 headings. Thus the planners can refer to a comparative table showing 105 occupations and 41 sectors of activity (referred to by the INED as "categories of economic activity"). This, in their opinion, is one of the advantages of this source of information, which has the added virtue of comprehensiveness, since it covers the entire active population. They nevertheless have a certain number of criticisms to make. In the first place, use of the survey formula entails reliance on statements by the individuals concerned. The danger here is twofold: people tend to exaggerate their qualifications, or at best replies may lack precision and therefore consistency. In the second place the nomenclature of 391 occupations drawn up by the Institut National de la Statistique et des Etudes Economiques (INSEE) is an old one, little concerned with the link between occupation and training. As already pointed out, it deals with occupations in uneven detail, and too sketchily with some which are open to highly skilled scientific and technical personnel. The ratio of such occupations, including those for technical staff, normally increases as changes in production and organisation methods are spurred by growth of the industrialised economies.

It is only when their work relates to certain branches that the Manpower Committee makes use of information provided by Ministry of Labour surveys. This information has the advantage of being based on statements by employers, who have a better knowledge of job structure and are free from the kind of psychological reaction which impels the individual to exaggerate his particular qualifications. But these surveys cover only the personnel of industrial and commercial establishments with more than ten employees. They cover hardly more than 40 per cent of the total active population, and are very incomplete in respect of occupations in such activities as commerce and agriculture (which may provide openings for certain types of special training) or construction, the public sector and the tertiary sector (which offer considerable opportunities for the type of personnel dealt with in this report).

Once the structure of employment by occupations is known, it is possible to prepare forecasts by applying the factors which influence both employment and the pattern of occupations.

Factors influencing the occupational structure

The Second Manpower Subcommittee endeavours, by a series of approximations, to define the occupational structure which will result from economic and technical changes and so forecast manpower needs in each occupation.

The first stage concerns each of the 41 categories of economic activity defined by the INED. It is further broken down into a linear-extrapolation phase and then a corrected-extrapolation phase.

A study is made of the data provided by demographic surveys in 1954 and 1962 and the changes they reveal in the occupational structure. It is assumed that technical and organisational changes will later lead to changes of a similar kind and rate (at least the most commonly accepted assumption is that the rate of change will remain the same). This calculation is based on the comparative table of 105 occupations and 41 categories of economic activity. As is noted in the second report by the Subcommittee, "the structure of employment by occupations, shown by percentages within each sector, in 1954 and 1962, has been projected by a linear method up to 1970 and 1978. The method of projection was to vary the ratio of employment in each group to total employment by a constant number of points".

It is obvious that linear extrapolation alone cannot result in a satisfactory forecast. Trends in the occupational structure between two reference dates do not fully reflect past changes in requirements. Certain shortages may not show up if during the period of observation the supply of qualified personnel produced by the educational system failed to meet needs in certain occupations, where the use of personnel having received other training regarded as roughly equivalent was either impossible or unwanted. This is another aspect of the de facto relationship between education and occupation, and one which will be reverted to later on.

Moreover, what was true for the past will of course not necessarily be true for the future. The shape of the occupational structure, as a result of new techniques and new methods of production and organisation, may well change at a different rate and in a different direction.

In this connection, the report by the Second Subcommittee recognises the fact that the information at present available does not enable the forecasts to allow for all factors which logically might have a bearing on changes in the occupational structure. The Subcommittee therefore resorts whenever possible to an imperfect but practicable solution. This consists in making use of the employment forecasts by occupational category established by the Plan's Modernisation Committees (vertical committees corresponding to branches of activity). These might be described as forecasts of an intuitive rather than a scientific character. But in this case it is intuition based on the experience of persons familiar at first hand with the operational conditions and problems of a particular branch of activity. This explains why forecasts of employment trends by occupation within each branch are often apt to be defined in terms of the optimum future structure of occupations. Here again the forecast is in the nature of an objective. The Second Subcommittee considers that such forecasts "constitute particularly valuable information concerning occupations for which extrapolation serves little purpose". An example it gives is that of teaching and research personnel, which at various levels correspond to highly qualified scientific and technical personnel.

Information supplied by the vertical committees not for correcting linear projections is however of uneven value. Each committee was thus sent, in the early stages of preparation of the Fifth Plan, a questionnaire for forecasting the breakdown of employment by occupational category in the branch of activity covered by each committee. Scientific and technical

personnel was divided into four groups: engineering and related grades - other senior personnel - draftsmen - other technical grades. But the replies received varied from one committee to another: some omitted forecasts of employment by level of qualification, others used different methods of forecasting. The report by the Second Manpower Subcommittee notes that such occupations as teaching and research were covered by very detailed forecasts (1).

These "provide very valuable information but they are not related to overall forecasts on the structure of employment in the corresponding sector; generally speaking, little information yet exists concerning patterns and trends of employment in the tertiary sector". It will once again be noted that the tertiary sector, a field likely to offer an increasing number of openings for highly qualified scientific and technical personnel, is one which ill lends itself to the forecasting process.

If the correction of linear projections is hampered by the uneven value of the predictions made by the vertical committees, this is partly due to the methods used by each and especially to the absence or inadequacy of the information required. A further obstacle to the correction of projections also raises a problem of information, to which no more than a passing reference will here be made. The report by the Second Subcommittee mentions the difficulty of adapting the forecasts by branch of activity supplied by the vertical committees to the linear projections by category of economic activity. The nomenclatures in fact are different in each case. Thus the vertical committees use the same for branches as the SEEF (Service d'Etudes Economiques et Financières du Ministère des Affaires Economiques et des Finances, reconstituted as a Forecasting Division in 1965). Projections of the occupational structure are based on the INED nomenclature of categories of economic activity, the only one affording comparability of the employment structure by occupation in 1954 and 1962, that is providing the minimum requirement of two past references on which to base a projection. The existence of two nomenclatures necessitates a certain amount of transposition made all the more difficult by the dissimilar areas covered (forecasts by the vertical committees generally relate only to wage earners, while in some occupations the proportion of non-wage-earners may be considerable). Admittedly this is only a commonplace, that is, an often encountered example of the unco-ordinated way in which information is collected and processed. From the point of view of the information process, which is the basic theme of this report, an effort to achieve conformity would nevertheless appear desirable. Should a change be made in the nomenclatures used for demographic surveys, which were pointed out as the basic source of information concerning the occupational structure (although this would inevitably raise the problem of comparability in time)? Or should the

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(1) For personnel teaching in state-owned establishments, forecasts are based on estimates by the School Investment Commission, calculated according to numbers of pupils, pupil-teacher ratios and service obligations of the various categories of teachers. As far as concerns research personnel, the detailed forecasts could not be fully taken into account because of the summary nature of the nomenclature, covering non-teaching personnel alone. The Second Subcommittee predicted an annual increase of some 10 per cent up to 1978.

number of surveys using the SEEF branch nomenclature.(or the very similar one of "sectors of establishment" used by the First Manpower Subcommittee) be increased, and the utilisation of economic projections as calculated in the national accounts for forecasting manpower requirements thus be facilitated? The specialists all undoubtedly have their own views on this subject.

Regardless of the difficulties described above, it is not without value to note how linear projections are corrected by the forecasts of the vertical committees. These forecasts were used "as rough indicators of manpower needs in the different sectors". They made it possible to correct linear projections "in thirteen sectors representing 40.4 per cent of the population employed in 1962, 45.5 per cent in 1970 and 50.7 per cent in 1978". (For the other categories of activity the linear projection based on percentage variations for the period 1954-62 was adopted). One of the most significant results of this correction is the increase - varying according to categories of economic activity - in the percentages of executive and technical grades as related to the projections.

The following table show: the size of these corrections in three categories of activity, together w. a the position of highly qualified scientific and technical personnel in the occupational structure (proportions are shown as percentages of total manpower employed).

Categories of activity and occupations	Linear projection			Corrected projection		
	1962	1970	1978	1962	1970	1978
Building and civil engineerir						
Executives grades	2.03	2.15	2.23	2.03	2.20	2.39
Technical grades	4.77	4.96	5.45	4.77	5.31	5.90
Draftsmen	1.28	1.42	1.67	1.28	1.61	2.02
Chemical industry						
Engineering and executive grades	6.36	7.04	7.99	6.36	7.89	9.61
Technical grades	5.48	7.17	8.99	5.48	6.75	7.97
Metals industry						
Engineering and executive grades	4.12	4.87	5.60	4.12	4.87	5.55
Technical grades	5.26	6.53	7.85	5.26	7.64	10.13
Draftsmen	2.24	2.45	2.65	2.24	2.99	3.60

The Second Subcommittee points out that "forecasts relating to research technicians (increase of 14 per cent per year) and to research staff employed in enterprises (annual increase of approximately 9.5 per cent) could not be used, as these posts are not shown separately under

"technical" or "engineering" grades. As a result recruitment needs with regard to engineering and technical grades are apt to be considerably underestimated.

Thus the first step, once the pattern of employment by occupations is known, is to predict the future pattern by means of corrected extrapolations. Strictly speaking, this step completes the study of factors influencing trends in the occupational structure. There is however another way to determine manpower needs by occupation. This is to match forecasts of the occupational structure with employment forecasts (in the light of changes in volumes of production and rates of productivity) for each category of economic activity concerned. In this way the pattern of employment can be forecast by occupation consistently with the expected growth of total employment, production and productivity. It will then be possible to turn from employment forecasting to educational forecasting.

B. Manpower requirements and educational planning

The last stage of the work of the Second Manpower Subcommittee is to use forecasts of employment by occupation as a basis for forecasting recruitment needs in respect of skilled personnel, and corresponding training requirements. Meanwhile the School Investment Commission, from its own particular angle, draws up the relevant educational plans.

1. Requirements concerning the recruitment of skilled personnel

The employment forecasting data enable two stocks to be compared: the stock of the present active population and its occupational structure as against the stock of the active population at the end of the period covered by the forecasts and its future occupational structure. Transition from the first to the second takes place through the action of inward and outward flows. These flows must be considered in terms both of recruitment needs by occupations and training needs. By concentrating on flows rather than on stocks alone, the logical approach to employment policy - as illustrated by the work of the Manpower Committee (1) - is that

(1) The conclusion to the General Report of the School Investment Commission states that it would be desirable "to improve planning techniques, as in forecasting numbers by developing a model that would make it possible to argue from flows rather than from the stocks it has hitherto relied upon". This would seem to be a reference to the fact that to estimate numbers in, say, higher education the method used is to multiply the percentage of a certain age group entering higher education by the average number of years of study. This method neither makes allowance for repeaters (although these may be accounted for by increasing the average length of school attendance), nor for dropouts. While a simplified method of approximation, it is nevertheless one which approaches the problem from the aspect flows from the system rather than stocks of trained personnel.

of the authorities responsible for the educational system, who are primarily concerned with the annual yield for different levels and types of education.

Recruitment needs by occupation

For each occupation recruitment needs by occupation are determined by two groups of factors: the variation in numbers at the beginning and at the end of the period covered by the forecasts, and replacement needs within the same period.

Bernard Grais (1) has made a very clear and detailed list of the factors to be considered. If, as he suggests, we set:

S_o = the initial total employed in a given occupation;

S_n = total employed at the end of the forecasting period;

d = total of deaths occurring during the period;

r = total retired or ceasing to work;

e = total leaving the occupation for other work;

i = total coming into the occupation from other work;

i' = inactive or unemployed persons coming into the occupation without requiring additional training;

then the flow of manpower necessary to provide the required stock is:

$$f = S_n - S_o + d + r + e - (i + i')$$

The various factors in this equation are obviously not all of the same importance, nor are they all equally known. Consequently only some of them have been taken directly into consideration by the Second Manpower Subcommittee.

The variation in numbers ($S_n - S_o$) depends on the forecasts to which reference was made earlier. Replacement needs depend primarily on the number of deaths, which can be estimated with the aid of mortality tables for the period considered. It is however necessary to know the age pyramids of the various occupational groups. This information is obtainable from population surveys, but between two surveys changes may occur due to shifts of occupation. Reference will be made later to the importance of such shifts in the case of highly skilled scientific and technical personnel: actually, the fact that they do take place primarily argues for a wider definition of the occupation. An accurate estimate of replacement needs which can be attributed to deaths should also allow for mortality differences as between occupations for which no detailed information is available. Hence it is difficult to say, for the type of personnel

(1) "Forecasting of the active population by occupation and level of skill" OECD, Paris, January 1966.

here concerned (1), whether errors of estimation are likely to occur on this account, but in any event it is doubtful that their effect would be significant.

Replacement needs also depend on the numbers retiring or ceasing to work. Here the ratio of activity according to sex and age must be taken into account. The Second Manpower Subcommittee has largely based its work on the activity ratios recorded in the 1962 census, while recognising the fact that the longer the period covered by the forecast, the more these ratios, which reflect attitudes towards employment, are apt to change. Only in the case of men between 60 and 75 years have activity ratios been calculated differently according to the occupational group and level to which the worker belongs. As B. Grais points out (op. cit. page 21) "the ideal would be to have working life tables for each occupational group, since habits in regard to stopping work probably differ widely from group to group, particularly among non-wage earners. The methodology of drawing up these tables could usefully be studied. It would no doubt involve in effect the institution of what amounts to a register of working life with compulsory declaration of the dates on which life started and ceased".

In any case replacement needs undeniably differ according to the category of economic activity (although it must be remembered that the same occupation can be found in several categories). Thus new and expanding activities, such as the petroleum and electronics industries, at present have low replacement rates compared with traditional activities say in textiles or crafts, where the average age of workers is higher. It may be added that the growth sectors are those where the need for highly skilled scientific and technical personnel increases most rapidly.

Any comprehensive analysis of replacement needs should allow for shifts from one occupation to another and deferred entries into the occupation (factors e, i and i' in the formula quoted above). These are what are generally known as occupational transfers, incidentally referred to on two earlier occasions. This will be the principal subject matter of Part II. Suffice it to say here that the Second Manpower Subcommittee felt that it did not have sufficient information to take occupational transfers

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(1) One possible suggestion, of no great originality, might be to distinguish between management personnel and other grades. The inclination would then be to claim that beyond a certain age the pressures imposed by the exercise of exacting responsibilities lead to higher rates of mortality among "active" than among "speculative" or "functional" staff. But differences in the type of responsibility generally correspond to differences in individual character. Those who accept the burden of responsibility would appear best equipped to bear it; hence it might be well to train engineers differently, depending on whether they will work for a consultant firm, in the field, or in a workshop. On the other hand, must the whole future course of a career thus be mapped out once and for all? Our conclusion should perhaps be that this is yet another reason why the content of occupations needs to be re-examined.

into account, except in one particularly important case, that of farm workers. Once recruitment needs for each occupation are known, it is possible to express them in terms of education. At this final stage, the usual planning approach towards employment policy moves away in the direction of educational policy.

Recruitment needs by level and type of education

The transition from occupational to educational planning "is made with the help of assumptions concerning the education considered necessary for each of the occupations covered by the forecasts". The occupation-education relationship has a normative character for two reasons. In the first place, it links each occupation to an academic diploma or level of study, although it is recognised that the necessary knowledge may be acquired by non-academic means. In the second place, the occupation-education relationship is defined according to the level considered desirable rather than the actual skill of present practitioners.

At the same time the establishment of such relationships undoubtedly depends to a great extent on the characteristics of the educational system. Thus the French planners have adopted a nomenclature comprising six levels of training, defined according to the duration of study after the "observation cycle" (which, as decided in 1963, comes to an end after the "troisième", i.e. at the end of the first cycle of secondary education. In "normal" schooling this first cycle ends at the age of 14). Highly skilled scientific and technical personnel correspond to levels I, II, III and IV, which entail an average of 11, 9, 7 and 5 years of study respectively, after the observation cycle.

Finally, to complete the analytical forecasts of recruitment needs by level and type of training, a comparison should be made with forecasts of educational flows for the corresponding period. These forecasts are related to the work of the School Investment Commission insofar as it provides data conducive to educational planning. In short, the task of the Manpower Committee is to translate the targets of employment policy in terms of medium and long-term education. The question now is how and to what extent the educational system takes these requirements into consideration.

2. The educational flows and educational planning

The Investment Commission for Schools, Universities and Sport, set up in connection with the preparation of the Fifth Plan, has formed several subcommittees which are responsible to it. The first of these, the subcommittee on "Numbers" has been given the task of forecasting trends in numbers of pupils and students to be admitted in the various categories of education. Its work is therefore immediately relevant to the present report, since its object is to forecast yields from the educational system. The principal aim of the investigations carried out by the other six subcommittees is to determine the material and human resources needed to achieve such yields. But in determining these resources account must be taken of certain constraints (financial and structural) over which the Commission has no control and which raise the question whether genuine education programmes can in fact be established.

Forecasting trends in the student force at schools and universities

Forecasts of the student force required at the various levels of education directly determine the amount of investment needed during the period covered by the Plan. Yields from the educational system are then predicted by means of realistic assumptions concerning the fraction at a given level of education which will move on to the higher level and the proportion of dropouts (1).

The way in which highly qualified scientific and technical personnel are classified above suggests that training takes place during the period of non-compulsory schooling (although a first choice of studies is made at the end of the first cycle of the secondary course, which is normally included in the period of compulsory schooling despite the fact that the school-leaving age has not yet been raised to 16). Thus forecasts of numbers must be based not only on demographical considerations, but also on factors influencing the school enrolment ratio.

There is no particular difficulty involved in taking into consideration the demographical factor. It suffices to take the number in each present or later generation (depending on the period covered by the forecast) and to project it over time, applying to each considered school-age population the corresponding mortality rates. These, while not strictly constant, barring any unforeseeable event are not subject to sudden variations.

The trend in school enrolment ratios may - according to the School Investment Commission - be examined in two ways. It is possible simply to extrapolate the recent trend towards spontaneous extended school attendance, or to set for each level enrolment and type of education an optimum enrolment ratio during some specific later year, and plot the trend curves accord-ingly. In this case the forecast has the value of an objective, as earlier explained, and the forecast attests to a target approach. The Commission has used the two methods simultaneously. Besides forecasting the trend by extrapolation, it has allowed for "the objectives to be achieved by the end of the period 1972-75, with regard to the differentiation of children in a given age group between the various streams that will be open to them at the principal stages of guidance in the educational system" (at the end of the first and second cycles of secondary education).

The Commission notes that the overall results obtained by the two methods are the same. On the one hand the spontaneous demand for education at all levels appears to be in advance of decisions concerning the extension of compulsory school attendance. On the other hand there is little danger that the deliberate setting of educational targets will create a supply of skilled personnel in excess of the economy's require-ments. Recalling that expenditure on education is in the nature of a pre-investment or permissive investment, the Commission considers that "forecasts relating to the economy's future need of workers with different levels of skill never make sufficient allowance for the further growth and

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(1) For instance, by taking into account a number of significant relation-ships between numbers of pupils or students at the various levels, such as that between the number of students and the number of "bacheliers" over the four preceding years, and between the number of "bacheliers" and of those who entered the "sixième" seven years earlier.

productivity capacity which added education and training can offer the nation". This observation is one which may well be kept in mind. Broadly speaking it supports the notion that on the market for skilled personnel the supply largely sets the demand, and that the needs of the economy are in fact determined by the levels and types of skill available. However, it is only from the general standpoint that supply can be said to be the determining factor. Given the general development of education and the trend in the industrialised countries towards longer school attendance, the needs of the economy as a whole will soon adjust to a society of secondary-school graduates, and later, no doubt, to a society of university graduates, engineers or the equivalent. In this case it is the average standard of education, if not of the whole population at least of the new generations, which will rise. But even with this change in the average level the problem of the choice between different lines of study remains. Furthermore, the Commission points out that while the trend in school enrolment ratios appears to be roughly the same whether the forecast is based on an extrapolation or includes the consideration of objectives regarded as desirable, it is much more difficult to foresee how, at a given level, the school population will be divided among the various possible educational processes. It therefore considers that preference should be given to a target approach, and that it may be desirable to influence spontaneous demand for education "no longer where access to a specific level of education is concerned, but in apportioning the school population among the various types of establishment and the different branches of instruction existing at that level".

This obviously is the stage where forecasting becomes important in the case of highly skilled scientific and technical personnel. Leaving aside for the moment the process of target forecasting, the realistic extent of which will be measured in the second paragraph of this section, the spontaneous trend in numbers and consequently the final output of this type of personnel proves difficult to foretell. In a detailed analysis which forms part of a model showing growth of the educational system, which by reason of its conception calls for extensive use of the electronic computer, Michel Vermot-Gauchy (1) points out that two groups of factors determine the trend of school-enrolment ratios. Some are of a sociological character and influence the family's bias for or against their children's further schooling. This in turn depends on economic, sociological and physchological factors. "Where the educational process is concerned, orientation depends on the parents' idea as to the careers which are open to their children. The choice is guided by considerations having to do with the social environment, while such outside influence as trends of opinion also play a far from negligible part". (p. 113). The second group of factors influencing the trend in school-enrolment ratios is of an institutional character. It is mainly a question of the educational system's capacity to admit pupils or students. According to this author the selected line of study very much depends on the facilities available, even at the higher education level. There is, admittedly, greater freedom of choice at this level, but material and financial considerations and the question of location

(1) "L'Education nationale dans la France de demain". Editions du Rocher; Paris 1965, pages 109 to 137.

play an important part. Mr. Vermot-Gauchy however believes that unless both these groups of factors "are analysed and if possible somehow quantified, a better knowledge of the school enrolment process will but slowly be acquired, and it will be difficult to formulate an enlightened policy for the guidance of coming generations". (p. 115)

Forecasts of the student force by the School Investment Commission apply to the new academic year 1972. The object is to determine the investments needed under the Fifth Plan; appropriations will be settled upon between 1st January 1966 and 31st December 1970, but the entry into service of the corresponding facilities entails an average delay of about two years. The forecasts cover the total school population (both private and public education, the latter covering establisments run by the Ministry of Education or by other authorities) except for higher education where only the State-run establishments are taken into consideration, "since at this level private education plays only a marginal role". It should be noted that the forecasts made by the School Investment Commission relate primarily to enrolment in schools and universities, since its role is to fix the amount of investment designed to provide the necessary facilities. The Commission's Report makes hardly more than an incidental reference to educational flows. This is because the comparison of forecasts of manpower requirements and those relating to yields from the educational system, strictly speaking, is the task not of the School Investment Commission but of another Working Party which will be mentioned in the following chapter. The Commission's report does however include a general table comparing the economy's manpower needs and the resources constituted by educational flows during the period 1962, 1970 and 1978. This table is too general to be of interest here, sinc[illegible] requirements and resources at level V (end of the s[illegible] ycle) and at levels I to IV (end of the long secondary [illegible] education). It is however accompanied by a note [illegible] h quoting. This states that "res[illegible] es from the school system, for the sake of simplification, have been calculated on the assumption that all children entering a specific cycle of study complete that cycle. The result is an overestimation which is difficult to express in figures but is nevertheless appreciable". This last observation is somewhat disquieting, since it suggests difficulty in quantifying the overestimation which results if no allowance is made for dropouts and failures at final examinations (1). This problem, like that of repeaters, is one which is often

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(1) An attempt has in fact been made in the Commission's report to arrive at a figure for this overestimation, not in order to calculate the output of one cycle of education but to determine the numbers entering the cycle immediately above. It was for this purpose, apparently, that use was made of the significant relationships, mentioned above, between numbers of pupils at the various educational levels. Thus the number of students in 1972 is estimated by working back over the years of study to the "sixième", taking into account at various stages (the "seconde" and "baccalauréat") a [illegible] nificant relationship which has the effect of reducing the initial flow. The same simplifying hypothesis is to be found in the reports of the Working Party responsible for comparing the needs of the economy and the resources of the educational system (Joint Working Party on "Occupational Training and Promotion").

mentioned and has moreover been the subject of extensive study (1). This would however seem to be a field in which there is a need for more information concerning not only past experience but ways in which this knowledge can be used in forecasting.

It should in any case be pointed out that in its forecasts of school and university enrolment the School Investment Commission has adopted two methods simultaneously. One method is to extrapolate past trends in spontaneous demand, the other method is more in the nature of definition of targets. This latter approach is mentioned several times in the Commission's report. It means, as we have seen, that a forecast in the strict sense is combined with planning objectives. The question which arises is to what extent, particularly in view of such a target approach, a national plan for education may be said to exist in France at the present time.

The problem of educational planning

Under French planning procedures as they now stand, the factors can be grouped under three headings: the jurisdiction and authority of the Commission responsible for studying educational processes - the planning aspects of the forecasts made by that Commission - ways of translating these target forecasts into actual facts.

It has already been indicated that the Planning Commission responsible for matters of education is the School Investment Commission. We saw in the introduction and again in connection with the analysis of student enrolment forecasts that the job of this Commission is to determine the facilities to be installed and the necessary investment. Thus, if only because facilities must be provided for a given number of pupils, and because these facilities will vary in character and location according to the type and level of education concerned, the Commission's conclusions will tend to provide the guidelines of a national education plan. Although the Commission takes the needs of the economy in addition to other factors into account, it still does not have an entirely free hand. This is apparent from the definition of matters falling outside the province of the Commission. The latter points out in its Report that "the general organisation of education and the determination of teaching structures and methods are exclusively the responsibility of the Ministry of Education and the Government". The problem hence consists in ascertaining the essential purposes underlying the general organisation and structures adopted. To begin with, it is fairly certain that they were mainly determined "from inside", the Ministry of Education, like any other Ministry, being careful to retain jurisdiction over its own province. This is not to imply that the system as it stands is impervious or by any means hostile to economic considerations. But the weight of these considerations depends on the way they are interpreted by the men in authority. Manifestly these officials are equally sensitive to other considerations: the traditional concept of education, social

(1) Cf. D. Blot: "Les Déperditions d'effectifs scolaires", in "Tiers-Monde", April-June 1965. W. Van Vlet: "Les Années scolaires perdues", in "Population 1963", n° 3; and in the issue of "Etudes Tiers-Monde" entitled "Problèmes de planification de l'éducation". Paris PUF 1964, articles by J. Proust on "Les Déperditions scolaires au Gabon" and by I. Deble on "Les Rendements scolaires en Afrique".

concern for the democratisation of education and the right to education in the special context of the industrialised countries, certain preconceived opinions concerning structures and methods of teaching, not to mention various political arguments. The general organisation of education may well constitute a consistent whole (1), but it does not necessarily follow that national education policy is fully integrated with national economic planning. Such integration, which the School Investment Commission would be in the best position to promote, is further limited by other restrictions on that Commission's competence. Since it is primarily concerned with equipment, "it plays no part in forecasting developments in the operational budget for education, although such forecasts undoubtedly constitute an essential component in formulating long-term education policy". Finally, even where investment plans are concerned the Commission's authority is limited to those carried out under the Ministry of Education. Thus neither private educational establishments nor the State establishments under Ministries other than the Ministry of Education (e.g. the agricultural colleges and certain "Grandes Ecoles", including colleges of engineering) are within the province of the Commission. It is true that in its enrolment forecasts the Commission takes private education at primary and secondary level into account, but it is not concerned with private higher education which is regarded, as we have seen, as marginal; nor does it apparently deal with private "Grandes Ecoles" or those which, although run by the State, do not come under the Ministry of Education. This may well prove a serious obstacle to knowledge of the output of highly skilled scientific and technical personnel, and to adjustment of the supply to the needs of the economy (2). The precise

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(1) In the preface to its Report the Investment Commission refers to some of the difficulties encountered, including "the almost constant process of reform which educational structures have been undergoing for the past two years". Some may point out that this endemic state of reform has lasted for a longer time, but the fact remains that the reform now in progress undeniably has a certain inter[illegible] gic, however much it may have been criticised f[illegible] rters.

(2) The Report by the School Investment Commission contains a table showing forecasts of numbers of engineers for 1972-73, divided into categories according to specialisation, and another breaking down these numbers between the different schools administered by the Ministry of Education. There are 70 schools of this kind, as compared with the 138 schools authorised in 1965 to award engineering diplomas ("Journal Officiel" of 24th July, 1965, in pursuance of Section 11 of the Act of 10th July, 1934). Thus more than half of the engineering schools are omitted in the Commission's forecasts, not only the large military colleges such as the Ecole polytechnique, but also such important State schools as the Conservatoire national des Arts et Métiers, the Ecole nationale supérieure des mines de Paris, the Ecole nationale des ponts et chaussées, and such independent technical schools recognized by the State as the Ecole spéciale des travaux publics, etc.

competence and powers of the School Investment Commission must be borne in mind when examining its Report. This "does not constitute a general programme for educational expansion over the next few years. But it does attempt to set the problem of equipment for schools and universities against the more general background of national education policy as defined by the Government and of social and economic development under the Plan".

To what extent – the second aspect of this problem in educational planning – do the target forecasts allow for economic and social development under the Plan? In view of the considerable amount of new investment necessary owing to demographic, economic and social changes, the Commission had to leave various improvements to conditions of education aside, considering that "priority should be given to achieving the social objective (democratisation of education) and the economic objective (training at all levels of executive and technical personnel meeting the country's needs". The economic priority is mentioned in various parts of the Report. Thus the forecasts for the second cycle of the secondary course, which determines the output from post-secondary education, are accompanied by a statement to the effect that the Commission was careful to consider the economy's requirements for personnel at the various skill levels. The Commission's Report however adds that these needs constitute "data which must be used with the utmost caution, both for theoretical reasons, since such forecasts always tend to underestimate the consequences of technical advances made during the periods concerned, and for practical reasons, since the relevant statistical information available is still inadequate". The "selective" quality of forecasts, at least insofar as based on economic needs, is consequently limited in two ways. A practical limitation arises, since the information at present available is hardly such as to enable accurate forecasts to be made of manpower requirements and expressed in terms of education. But there is also a more fundamental limitation: from the theoretical standpoint, it seems that the Commission is generally reluctant to forecast manpower requirements as a basis for national educational planning.

This being granted, the Commission has nevertheless made a point of comparing its forecasts of trends in school enrolment for the different cycles of education and particularly at the level of post-secondary studies – and trends in the economy's needs. It follows therefore that forecasts should assume the character of objectives once school attendance becomes no longer compulsory. The Commission considers that "in certain cases one might legitimately influence the demand for higher education so that the training given in educational establishments will match that needed for development of the French economy". One of the prime objectives of the Commission is to increase training facilities for highly skilled scientific and technical personnel. In its opinion the share of science compared with that of arts and letters should be larger. A further aim is to develop a new branch, the University Institutes of Technology designed to produce middle-level technical personnel (1). Thus despite the various reservations mentioned at the beginning of this paragraph we have here some of

(1) Allowing for the combined populations of the Science Faculties and the Science Departments of the University Institutes of Technology, the aim is to reach by 1972 the target which the authors of the Fourth Plan hoped to achieve by 1969 in the Faculties alone, i.e. 42 per cent of all students engaged in scientific studies.

the elements of a national education plan, set in the more general context of the economic and social development plan.

The next question to be considered, as the third and last aspect of the problem of educational planning, is how target forecasts can be converted into fact where education is concerned. This is a question which ill lends itself to practical solution.

French planning is of an indicative rather than an imperative character, a feature which becomes even more marked where education is concerned. Guidance towards objectives considered desirable can be only be incentive. This brings up the whole question of the means and ends of school and university guidance.

In practice guidance is all too apt to be of a negative character. Reference is often made to guidance following upon failure, or to the fact that guidance is reserved for the mediocre student. This reflects the view held by families and their children that a hierachy divides the various educational processes, a view which is partly objective and partly influenced by social status. The most common illustration of this is a kind of social disparagement of technical and occupational training as compared with general and academic studies, and which is manifest in both developing and industrialised countries (although in industrialised societies the development of techniques together with the gradual elimination of the purely manual aspects of such work is helping to make it rather more respectable). Once a kind of selection platform is reached leading to several types of training marked by a certain hierarchical concept, school and university guidance can easily be looked upon as a screening process designed to limit access to the higher rungs of the ladder.

All educational systems are concerned to some extent in the search for positive methods of guidance. Once some likely pattern of future openings corresponding to economic needs emerges, how can the right number of pupils and students be guided in the desired directions? How can the abilities corresponding to each type of opening be assessed, and each individual be prevailed upon to choose the line of study for which he is most suited? The question requires a particularly sensitive answer when the number capable of pursuing a particular course of study is smaller than the output the economy demands. Should methods of teaching then be revised, and the whole educational structure be changed? Caution is called for, in view of what Mr. Vermot-Gauchy calls the interdependence of educational factors (op. cit. page 125). If, for example, he says, Science Faculties wish to increase their student force, they may facilitate access to the various courses of study they provide (which raises the problem of equating the quality of the Faculty's output to the economy's needs). But it is important that they should allow for decisions taken by other higher education establishments. Finally, the effects of decisions taken higher up the line must be considered, as they may lead to changes in student numbers and in their distribution between the different cycles of education. One of the objectives of the current reform of education in France is thus to achieve greater homogeneity of the educational system in the first cycle of the secondary course, and so make it easier to ascertain just what abilities lie in reserve for guidance later on.

While it is important to watch for "side" effects (changes affecting some other educational process following an identical guidance stage) or "upstream" effects which may tend either to increase or to restrict the

flow, it is evident that school and university guidance policy may also be determined by "downstream" effects. The kind of guidance which can translate target forecasts into fact may be influenced by available capacity in the disciplines where expansion is desirable, or by information concerning the needs of the economy, i.e. possible openings. The Report by the School Investment Commission however points to the experience gained under the Fourth Plan, which showed that "to guide young people entering higher education into new lines of study it is not enough to adapt the facilities that will be available to them". Its conclusion is therefore that job guidance must be approached from all angles, although "existing structures are apt to be so solidly entrenched that any re-orientation of the school and university population can yield results only after a fairly long period".

To conclude this chapter, therefore, it will be seen that, in addition to forecasting manpower requirements by occupation, forecasts relating to numbers of pupils are made in France, whence educational flows by level and type of training can be estimated. It will have been noted that enrolment forecasts are not part of a real national education plan, and that however target-like in character the foreca[illegible] do not take the future needs of the economy alone into account. Such needs are not ignored, however, and the fact that they are considered indicates a current tendency to relate prospects affecting both economic growth with development of the educational system.

C. The convergence of employment and educational forecasting

It is likely that convergence will only partially be achieved for some time to come, since an educational system is governed by a combination of factors, among which economic considerations have only recently come to be included. The objectives of education thor[illegible] for some of the obstacles to such convergence. However, [illegible] one accepts an economic objective for education, confrontation of the employment and education aspects calls for a series of steps which, as explained in the two previous chapters, have not yet been fully worked out. The exercise has, moreover, relatively little meaning unless a direct institutionalised confrontation procedure is established, as was attempted for the first time in France in connection with the preparation of the Fifth Plan.

1. The objectives of education

From the standpoint of economic analysis the national educational system may be said to "produce" education services. It is at the centre of a two-way movement of supply and demand. On the one hand it offers facilities for education which are matched against a demand for education – a demand based on social and cultural factors and influenced by demography and individual ability as well as by a complex combination of social attitudes. Demand is often qualified as "spontaneous", a doubtful adjective but one which can be explained by the fact that demand springs,

as it were, from a natural reaction to things as they are, rather than from any rational conception of things as they should be. On the other hand, the national education system offers a diversified "finished product" in the form of individuals who have acquired a certain type and a certain level of education. This supply is set against a demand for trained personnel on the part of the users, in this case the economic agents who create employment opportunities. The user can, of course, be the recipient of education, as in the case of independent workers. The existence of these will also depend on general economic conditions however.

Since the "educated" product is intended for long use (normally throughout working life), user demand, which is based on economic factors, is logically influenced by prospects of economic and social growth. Demand on the part of those seeking education may moreover be said to be influenced by that of the users. This is all the more true as the development of mass education tends to reduce the relative importance of demand for its own sake.

The aim of the educational system will therefore be to satisfy either the demand for education on the part of the direct recipients, or the demand for educated persons on the part of the economic users. From the way we have outlined the problem above it can be seen that neither type of demand can exclude the other, and that the aims of the educational system are several. When the adaptation of education to economic needs is concerned, the issue of course is whether certain objectives should be given priority over others.

Nature of the objectives

It is generally agreed that the aims of any educational system are many and varied (1). For a community a [illegible], according to Pierre Bourd[illegible] [illegible]ational system fulfils, in varying degrees, five functions, which he divides into two groups.

These functions - or community objectives - may be oriented inward - in this case they are primarily directed towards the preservation of culture. Such an objective, according to P. Bourdieu, is threefold:

(i) To uphold traditional culture;

(ii) To transmit the traditional culture by a process of "indoctrination", the product of which is the educated man corresponding to the community ideal (or at any rate that of the élites in the community);

(iii) To enable culture to perpetuate itself, particularly along the lines laid down by the community for education and research (problem of the "disciple" whose principal goal is to model himself upon his "master").

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(1) The observations which follow are mainly based on discussions at a seminar on "Les Finalités de l'Education" organised in March, 1966, by the Institut national d'administration scolaire (INAS), and more particularly on a paper by Pierre Bourdieu "F[illegible]s et fonctions du système d'enseignement" (to be published by the INAS).

The accuracy of this analysis may be criticised as favouring cultural conservatism and so imbuing the educational system with a reactionary character from the social standpoint. If it is true that every educational system is a product of history, it seems surprising that many authorities should regard education in developing countries as one of the essential forces of change in thinking and social patterns, the sine qua non of true economic and social development. Admittedly this is a view apt to be based on wishful thinking rather than on experience. According to some (1), the study of anthropology shows how grimly a people will cling to its basic values, even when social patterns have vastly changed. Just how effective formal education is or can be in changing such basic values is, they claim, impossible to tell. As for educational systems in the industrialised countries, their conservative character is often mentioned (2).

In addition to the internal functions of the educational system, P. Bourdieu defines two external functions designed for the individual's adjustment. One is concerned with integration in the community: whether morally by giving individuals a set of values as homogeneous as possible to strengthen their attachment to the community, or intellectually by imparting a culture conceived as a classified system of thought. The other function is to prepare the individual for a trade or occup[illegible] so help to meet the economy's requirements. This is not [illegible]ly [illegible]ctive of the user, who creates employment opportunities, but also to [illegible]ome extent that of the individual recipient, who has a variety of motives in seeking an education (income, security, satisfying work, prestige, etc.).

According to the sociologist's analysis therefore education has three separate objectives - the first three mentioned being, as we have seen, inseparable components. Mr. Vermot-Gauchy (op. cit. page 242) defines, in different terms, a similar three-fold set of objectives. "One essential university task is to develop in the child and in the adult the knowledge and the abilities of a man skilled in his occupation. This first objective of education corresponds to what may be described as a directly productive investment. But education has two other objectives: to develop a spirit of understanding and co-operation in the different social groups (school, family, enterprise, town, nation, group of nations), and to teach the child and adult to enjoy activities which enrich the mind and exalt concepts of living, that is, to instil the abilities and knowledge which properly belong to the cultivated individual. The first of these two latter objectives corresponds to what one might call a social investment, and the second to an investment in employment".

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(1) Th.L. Reller and E.L. Morphet: "Comparative Educational Administration", Prentice Hall, Englewood Cliffs, N.J.,1962, page 385.

(2) This idea is implied in several passages of the study quoted above by M. Vermot-Gauchy. From the different standpoint of the consulting engineer may be added a statement by Octave Gelinier (referring apparently to France) to the effect that "programmes of higher education are mainly suited to a preindustrial society". ("Morale de l'Entreprise et Destin de la Nation", Plon, Paris 1965, page 92).

The objectives of education hence vary greatly, and the economic objective is but one of them. Yet need it be regarded as the primary objective?

Ranking the objectives

The economic objective is but a recent adjunct, since most educational systems were earlier careful to guard against any utilitarian intrusion. So long as job experience carried more weight than the more theoretical knowledge provided by formal education, and so long as access to some important posts depended upon money or social class rather than on technical qualifications in the broad sense, economic considerations remained in the background. Only with the development of mass education did they come to the fore, when the financial implications caused the burden to be more judiciously spread and an increasing number of individuals - particularly those moving on to post-secondary studies - to be helped in finding employment consistent with the standard of their education.

In fact, although equating the output of the educational system to needs makes good economic sense, it is not necessarily the most important consideration. If, as suggested in the preceding paragraph, the leading objectives of education are three in number, the evidence shows that they are not necessarily fully compatible and may even conflict with each other. Take the cultural and social objectives: to what extent is the effective democratisation of education conducive, at least temporarily, to debasement of the population's average cultural level, thus promoting the emergence of new values among the ruling elite and so giving rise to social upheavals? If priority is given to social objectives does this not mean that, owing to the problems thereupon facing the educational system (numbers - material and human resources - teaching programmes and methods, etc.),training qualified personnel needed by the economy must go by the board? If preference is given to economic objectives, will this not run counter to traditional and firmly entrenched views promoting the defence and dissemination of culture?

These circumstances show how hard it is to define the future pattern of education in terms of economic needs alone, hence to match educational and employment forecasts completely.

As Roger Grégoire points out (1), educational systems evolve independently of the requirements of the economy. "Changes are dictated by political considerations, such as the desire to give an equal opportunity to all citizens or do away with class barriers as far as possible, or by the pressure, often irrational, exerted by society on the authorities to increase the opportunities for learning at increasingly high levels or lastly by purely educational considerations. There are people who even detect some opposition between the factors governing the reform of education and those on which economic development depends. Thus in Germany industry in general is openly hostile to a reform of the educational system recommended by educationists and by some political leaders, because they regard it as a threat to the present conditions of apprenticeship".

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(1) OECD Manpower and Social Affairs Committee. Report on Vocational Education. Roneoed document MS/M/307/179, Paris, 19th January, 1966, p. 40-Restricted.

In France we thus find the essential decisions conducive to the Fifth Plan to have been based primarily on demographic trends and on a global model showing the distribution of individual abilities among the leading disciplines. The work of the Manpower Committee had in fact not yet been completed when the main aspects of educational policy were formulated. Nonetheless, during the preparation of the Fifth Plan new methods were introduced and economic needs were taken increasingly into account in defining educational guidelines.

2. Consideration of the economic objectives of education

The conclusion of the Report by the School Investment Commission notes that the Fifth Plan "still largely relies on traditional methods of extrapolating pupil numbers, and its chief aim is to make advance arrangements for the equipment and personnel resources needed to satisfy spontaneous demand. But while estimating needs to be met it also defines a few desirable targets. It has thus correlated, at different levels of qualification, the educational system's output of graduates with the economy's personnel requirements, and on this basis has worked out optimum hypothetical breakdowns. It therefore recognises that, while the first necessity is to ensure that educational facilities are consistent with the demand for education, there is also the second necessity of ensuring consistency between training and development needs". This implies convergent employment and education forecasts: by what means and to what extent can convergence be achieved?

Institutional arrangements promoting the convergence of employment and education forecasts

Recognition of the need to bridge the gaps between formal education and working life is no new development. To mention only the case of France, even before the Second World War it led to the creation of the "Conseil supérieur de l'enseignement technique". In 1948 and later years, 28 National Vocational Commissions were set up for each trade group (metallurgy, chemical industry, building and civil engineering, distribution, etc.), composed of representatives from the Government, the teaching profession, employers, and workers' trade-union organisations. These Commissions, together with the "Comité National Interprofessionnel" set up in 1951, have played an active part in the preparation of public examinations giving access to different levels of employment.

The need for a wider outlook finally led in January 1959 to a decision to create the "Haut-Comité de l'Orientation et de la Formation professionnelles" under the chairmanship of the Minister of Education, whose task is to "propose measures promoting fulfilment of the economy's personnel requirements and various technical activities essential to the nation's life" (Article 39 of Decree n° 59-57 of 6th January, 1959 concerning educational reform). This Higher Committee did not meet until 7th February, 1963, although its working bodies (permanent section and working parties) held a number of meetings during this same year. Since then its proceedings appear to have come to a standstill. It was to have met again in April 1966, but at the last moment this resumption of activity was postponed, apparently sine die.

This Committee is (or was) primarily the mark of an intention. According to internal records of its proceedings and those of its Working Parties, it may be described as a permanent study committee with general terms of reference whose principal role is one of co-ordination. It seems, however, to have mainly dealt with the vocational training of junior, intermediate and senior technical staff. Its Working Parties were concerned with an inventory of methods of vocational training, with vocational guidance and with forecasting the economy's various skill requirements. The Working Party dealing with this last subject, which has most direct relevance to the present report, studied work done abroad, or incidentally in France, under the auspices of certain trade associations. It paid particular attention to the work of the Manpower Committee. But the Committee did not become an institutional part of the planning machinery, and despite its diversified composition seems to have been subservient to the representatives and views of the Ministry of Education.

Yet the Committee appears in some degree to have been the forerunner of the Joint Working Party for "Occupational Training and Promotion", stemming from the decision to associate in actual preparations for the Plan a body specially responsible for promoting consistency between training programmes and growth requirements. This Joint Working Party has neither the authority nor the means for proposing any precise training policy. "This commission is responsible for co-ordination and consolidation, its essential task being to collect all available information on the subject and to supplement as need be so as to forecast training needs measured against resources, and to suggest action promoting any necessary adjustment. Its composition makes it a link between the Plan's various Working Parties and the Ministries helping to prepare and carry out the Plan. Yet its membership - at the time of the last meeting scheduled for 15th April 1966 - suggests that the trades are under-represented: 9 out of 39 representatives for the private and public sectors, while, unlike the "Haut-Comité", it has no representative from trade-union organisations.

Within a fairly short time the Joint Working Party drafted a report (July 1965) in preparation for the Fifth Plan. Although this is in many respects a provisional document it has the merit of being a first attempt to balance training needs against resources. As such, it claims to do no more than indicate orders of magnitude and outline trends. It is defined as a summary report, and does not pretend to replace studies made by the various services or specialised committees, but proposes to compare these studies, to complete them by surveys and to introduce a common methodological language. The essential task of the Joint Working Party is to confront manpower needs and resources, something which in France has hitherto been done only exceptionally or to a limited extent.

The fact that this Joint Working Party is mentioned after the Manpower Committee and the School Investment Commission does not mean that this is the logical sequence of proceedings. It is simply that the Joint Working Party, a body concerned with co-ordination and confrontation, was set up later than the others (1). The ideal arrangement

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(1) The Investment Commission and Manpower Committee began work in mid-1963, whereas the Joint Working Party, which it was decided to set up in September 1964, did not come into being until January 1965 or begin operations until March of the same year.

- which it may be hoped will eventually prevail when plans are prepared - would be for the Manpower Committee and the School Investment Commission to proceed along parallel lines and, when a certain stage has been reached, for the work to be almost constantly co-ordinated through the Joint Working Party. By a series of adjustments (in the absence of a complex model balancing out all the factors at once (1), which is unlikely to reach practical development for some time), the confrontation of employment and training forecasts should lead to the revision of employment projections, hence if necessary of production targets, as well as of training projections. In view of the experimental nature of the Joint Working Party's activities and the very general character of its first assessment of needs and resources, only very tentative conclusions however can be advanced concerning the convergence between educational action and economic growth requirements.

Degree of convergence of employment and educational forecasts

The balance sheet setting needs against resources drawn up by the Joint Working Party covers the periods 1962-1970 and 1962-1978. Forecasts for 1970-1978 are described as partial and uncertain. As we have seen, flows are compared: on the employment side (needs) flows represent the amount of renewal and expansion required, and on the training side (resources) flows are expressed in terms of level of education. This assessment is much too general to show the position with regard to highly skilled scientific and technical personnel.

If the levels of training of such personnel (but including other types of training) alone are considered, the balance sheet over the period 1962-1970-1978 shows a deficit. And it is certainly underestimated, since to simplify matters it is assumed that every pupil entering a cycle of study follows it through. For the period 1962-1970, a considerable imbalance appears at university levels I, II and III, with resources meeting only half recruitment needs. The deficit is however reduced towards the end of the period. At level IV over 90 per cent of recruitment needs are met for the period as a whole. For the period 1970-1978, apparent equilibrium is reached at level IV, but one which is unsatisfactory from the qualitative aspect. At the university levels resources are expected to cover only 80 per cent of requirements over the period as a whole, although the annual university output should approximate annual recruitment needs from 1975 onwards.

The forecasts - at any rate insofar as they reliably indicate general trends - hence reveal an inadequate degree of convergence between training and employment, even in the long term. One question discussed in the introduction to this report which emerges here is the difference of economic horizon: even if the original trend is changed, employment

(1) In this connection we should mention the work of the "Centre d'étude de la prospection économique à moyen et long terme" (CEPREL) (Centre for medium and long-range economic forecasting) the aim of which is to develop a dynamic model for optimisation purposes. Under the direction of Jean Benard, this consists in defining and calculating the optimum allocation of resources between the national economy's various sectors, one being the educational system.

policy can hardly overstep the medium term, whereas education policy - so far as it concerns highly skilled personnel - is a long-term affair. A second question is the inertia of the educational system and the impact of existing structures (1): although it must be admitted in all fairness that the sponsors of present educational reform in France stress the importance of setting up new structures based on requirements which may be reasonably foreseen for the more industrialised society of tomorrow rather than on needs as they stand today (2).

It is therefore natural enough that the Joint Working Party should have concentrated on how better to adapt education and employment at shorter range. It defines the components of a largely cyclical policy which can also serve to correct imbalances or possible forecasting errors.

According to the report by the Joint Working Party, "wherever, qualitatively speaking, the school system does not entirely satisfy actual requirements, adjustment and adaptation may take place through training schemes outside the school system". In connection with the work of the Joint Working Party, the services of the "Commissariat du Plan" carried out a survey among public and private industrial undertakings to ascertain how many people were trained by them annually and what their plans were for development. This informational method is a positive contribution, and one which can be followed up and extended.

Recognition of the part played by training schemes outside the ordinary educational system has moreover led the authors of the Fifth Plan to raise the question of re-assigning the tasks of occupational training and re-training. "All too frequently - they write (3) - firms are inclined to rely on the educational system for what they alone are in a position to develop - men adequately suited to practise a specific trade or to perform a certain job. In a dynamic economy, in which the skills required are constantly changing, the pursuit of such an objective imposes a considerable strain; it necessitates an increased number of specialised diplomas; it calls for a stock of machinery which it is too costly to renew rapidly; it requires a considerable number of special facilities for training pupils, and refresher courses for teachers and practical instructors. This overspecialisation is moreover hardly compatible with the aim

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(1) Certain phenomena which have been noted in connection with education are similar to those which economic theory refers to as the acceleration principle in connection with capital formation. Any adaptation of the educational flow to meet economic requirements tends to cause much more marked variations in demand relating to the educational system itself (equipment, teachers etc.), frequently accounting for delays in adaptation. See Moorthy and Thore: "Accelerator Theory in Education", in "Indian Economic Review", February 1959 p. 57 to 69; B. Grais, op. cit. p. 8; M. Vermot-Gauchy, op. cit. p. 97-98.

(2) See the statement made to the Joint Working Party on 15th April, 1966 by Pierre Laurent, Secretary-General for Education, "Education nationale", CUIP, Paris, 2nd June, 1966, p. 7 et seq.

(3) Act n° 65 - 1001 of 30th November 1965 approving the Economic and Social Development Plan, Journal Officiel, "Lois et Décrets", 1st December, 1965, p. 10603.

of providing the general training forming a part of normal education". Hence the idea of a sharing of authority: the Ministry of Education would be responsible for education up to various stages related to levels of technical skill, while firms, in liaison with the appropriate Ministries, would undertake to provide short training courses.

The validity of such a scheme may well be questioned, since it would mean - at any rate during the Fifth Plan, regarded as a transitional period owing to the current educational reform and the considerable gap between needs and resources - relying heavily on training schemes outside the school system. Would it thus be logical to establish this division of responsibility on a permanent basis?

Actually such a decision appears justified both on rational grounds and by circumstances.

It is logical and rational since it recognises that if manpower resources are to be equated to the needs of the economy every method of training must be taken into consideration. It is the product of circumstance in that the relative inability of making forecasts resulting in a completely satisfactory adaptation of education to economic needs is admitted. True, it may be argued that adaptation can never be wholly adequate owing to such insuperable obstacles as the autonomy of any educational system and the impossibility of forecasting economic trends and their impact on employment beyond some span of time. Consequently a margin of short-term adaptability will always be necessary. Yet some progress can undeniably be made towards achieving a sharper convergence of education and employment forecasts, not only by means of institutions enabling a more fruitful dialogue between trainers and users to take place or by applying teaching principles promoting the adaptability of manpower, but from the methodological and perhaps even more the informational aspect.

II. Possible Improvements to the Information Process Conducive to a Closer Adaptation of Training to Economic Needs

One of the conclusions of the Report by the School Investment Commission for the Fifth Plan is that "a considerable effort must be made to assemble more reliable and more carefully processed information, as well as to promote further study and research on the educational system and the needs it must satisfy".

What improvements could be made to the information process so that yields from the educational system can be more closely co-ordinated with economic needs? The concluding comments in the preceding chapter give some indication of how far improvements can go. It must thus be acknowledged that no complete or continuous adjustment of supply of trained personnel can be achieved in the light of economic requirements. This is still true if adaptation is to take place primarily through the

younger generations, that is, instead of setting the stock of educated persons at any particular period against the total number of jobs, by comparing yearly educational flows with needed replacements and further numbers of trained personnel. Such major obstacles to overall adaptation were mentioned as differences of economic horizon, inertia of the educational system, special objectives of education, etc.

But our review of the principal stages of employment and educational planning in France also showed that present measures could be more accurate and detailed if they were less frequently hampered by informational bottlenecks. We have no intention here of drawing up an exhaustive table of possible improvements, and it would thus be idle to revert to points discussed fairly extensively in Part I. There is, for example, the question of the present state of knowledge concerning the educational flows at different levels and, especially, of methods of forecasting such flows. Reference was made to the important problem of repeaters and dropouts, which must be taken into account when calculating annual yields from original numbers. It would be useful to have a better understanding of this question, and, particularly, to obtain a somewhat clearer idea of what becomes of these pupils or students who disappear before the normal end of the cycle of study in which they enrolled. There is a need to work out a methodology which would promote a more critical approach to these questions, not forgetting the subject of parallel studies which are of definite importance at the level of certain courses in higher education. The forecasting of educational flows for the different levels and types of training would also be facilitated by a better definition of the factors and motives governing the choice by parents and children at certain stages of guidance. How much importance attaches to existing structures, available facilities, teaching methods, intellectual capacity, etc? The authors of the Fourth Plan are known to have anticipated some degree of orientation towards scientific studies, which did not fully materialise. While the School Investment Commission for the Fifth Plan based its forecasts of numbers on the percentage distribution between the various lines of study, the authors of the Report themselves admit that it was only a very rough working hypothesis. These percentages do not in fact reflect any precise knowledge of the real situation, since they relate to a new educational pattern which has yet to meet the test of experience and attitudes in full. Another reason is that these percentages appear to represent no intention on the part of the educational authorities to introduce any basically compulsory form of guidance.

A further point to be borne in mind is that information and the forecasts which follow should cover all types of training (1). The Joint Working Party has recognised this fact, and has endeavoured to make a survey of training activities and output outside the educational system. It would also be preferable, as previously noted, for the work of the School Investment Commission not to be confined to those establishments which come under the Ministry of Education, as are enrolment forecasts

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(1) The Secretary-General of the Ministry of Education himself recently drew attention to the lack of information on some questions. "We know little, for example, about the training given outside educational establishments". See the 2nd June, 1966 issue, already quoted, of "Education nationale" page 33.

for engineering colleges. The sharing of responsibility and past vicissitudes have led to a certain amount of compartmentalisation, but there is no warrant for its extension to planning.

Having thus stressed the importance in forecasting yields from the school and university system of improved sources of information, we can now confine ourselves to two other aspects of the information process. Looking back to the principal stages in the forecasting process, two appear to be handicapped owing to the dearth of information, quite apart from any questions of methodology that may arise: knowledge of future manpower requirements in terms of training. When considering these problems in connection with present planning procedures in France, Part I, various references were made in passing to the subject of information. It is time to consider them again as the key question, though once again we make no claim to be exhaustive. It may be added that a problem which arises at the two stages mentioned above is that of a nomenclature of occupation. But while such a nomenclature is needed to forecast the future occupational structure, it is from the angle of the occupation-training relationship that the content of existing nomenclatures and its adaptation to forecasting requirements will be dealt with.

A. Forecasts of manpower requirements

These forecasts are linked with forecasts of economic trends but only when the latter are sufficiently accurate and detailed to allow at least the main classes of jobs the economy will have to offer to be known. A certain limit must however be kept in mind from the outset: specialists today are generally agreed that beyond a period of four or five years it is very difficult to forecast production by sectors of economic activity and to foresee changes in production techniques. It should therefore again, and for the last time, be stressed that the horizon of economic forecasting and the length of training of highly skilled personnel can never exactly be made to coincide.

This consideration apart, two types of informational problems appear to arise when the "economy - jobs - occupational skills" relationship is approached from the forecasting angle. One type relates to knowledge of the pattern of employment by occupation, and the other to forecasting procedures, particularly the assessment of the effects technological advances have on employment and the occupational structure.

1. Knowledge of the structure of employment by occupations

One of the conclusions of the Report by the Second Manpower Subcommittee is that "although very substantial progress has been made over previous plans, the forecasting of skilled manpower requirements is still somewhat of an experimental nature. In order to place the forecasting of manpower needs on a sounder footing ... the statistical data concerning the occupations and skills of the active population must be improved and developed to the utmost ...".

In Part I (Chapter I, Section 2) population surveys were described as the essential source of information, and it was stated that these left much to be desired. It may be hoped that other surveys necessarily less wide in scope than the population surveys, but carried out under more favourable conditions and on the basis of a more detailed questionnaire, will enable a better knowledge to be gained of the employment pattern for certain occupations generally matching certain types of training. Where highly skilled scientific and technical personnel are concerned, some surveys have already been carried out and others may be undertaken. Of these some may be described as of a partial kind, since they neither cover all highly skilled scientific and technical personnel, nor all of the economic sectors where it might be employed. Other surveys can be regarded as comprehensive, since samples, some larger or more representative than others, are taken of the whole active population.

Partial surveys

Employers' associations normally have adequate facilities for sending detailed questionnaires to their members, and can usually expect a satisfactory number of replies. An interesting study concerning engineering and senior executive grades in the metal industries has been carried out by the UIMM (Union des Industries Métallurgiques et Minières) under the direction of Yves Corpet, who has since been appointed Rapporteur général of the CNPF (Conseil National du Patronat Français) for Education and Training, and who is also a member of the Joint Working Party on "Occupational Training and Promotion". This survey was first carried out in 1956 and was repeated in 1962. Its value as a source of information lies in the fact that in 1962 it covered 943 establishments representing a total of 732,377 employees, including 30,121 in the engineering and senior executive grades. In the course of the survey one question the firms were asked was to indicate the present distribution of their engineers and senior executives according to duties and basic training (mentioning any holding two or more diplomas). The example thus set by the entire metal industry, composed of eleven distinct branches (mining, iron and steel, etc.), is one which might well be followed by other employers' associations, if possible by a survey conducted along similar lines.

Other surveys, still of a partial kind but covering a larger number of sectors, provide the basis for the report by the Study Group on "the conditions of development, recruitment, operation and location as applied to the "Grandes Ecoles" in France" (1). This Report, generally known as the "Boulloche Report" after the Chairman of the Study Group, is based on a sample survey of 2,200 private firms, the main nationalised undertakings in the official industrial and commercial sectors, and the civil service. In addition the Report makes use of findings under the 1962 UIMM survey. The sample survey included "a detailed questionnaire in the form of a table equating the functions actually performed with the types or levels of training received by engineering and executive grades".

(1) La Documentation française, Paris 1964, Recueil et Monographie n° 45.

It will however be noted that in view of the Study Group's special aims the sample survey shows no breakdown by sectors of activity, unlike the other surveys whose results are summarised in the Boulloche Report.

A survey designed to cover the total number of "ingénieurs diplômés"(1)(2) was carried out in 1963 by the FASFID (Fédération des Associations et Sociétés Françaises d'Ingénieurs Diplômés). Among other things, this enabled the distribution of graduate engineers to be ascertained by sectors of activity (some corresponding to the industrial branches of the UIMM Survey) and according to their duties in the firm (corresponding, although the nomenclature is less detailed, to the job classification used in the Boulloche Report).

Each of the three surveys mentioned above constitutes a method of furthering knowledge of the occupational distribution of highly skilled scientific and technical personnel. In the first case the survey was initiated by a trade association, in the second as a result of the Prime Minister's instruction to an <u>ad hoc</u> study group, and in the third by an association of graduate engineers. It would be desirable, however, for surveys of this kind to cover all such personnel. The type of occupational structure on which information is compiled moreover shows dissimilarities, due to the diversity of motives which inspired the surveys. Apart from the question of a co-ordinated nomenclature, the breakdown by sectors of activity essentially follows the lines used by the Manpower Committee. But the job classification method used in the Boulloche Report, when set against the type of nomenclature used for scientific and technical personnel by the Manpower Committee, shows there to be room for discussion at some later stage on the concept of "occupation".

The statistical material covering highly skilled scientific and technical personnel in France is manifestly very poor. One of the difficulties lies in the relative vagueness of the concept of highly skilled technical personnel and in the fact that the educational processes for this type of personnel have changed several times in the past and will change once more with the advent of the university institutes of technology.

However, there is one type of personnel for which regular and fairly detailed information should be easy and cheap enough to obtain. These are the graduate engineers who, we saw, are not taken fully into consideration in the Report by the School Investment Commission (numbers of engineering students in colleges run by the Ministry of Education). Documents published by the FASFID (3) provide a fairly

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(1) Social survey on the situation of graduate engineering staff 1963. Statistical annex to the "Feuillets documentaires" of the "Bureau universitaire de statistique" (BUS) May-June 1964. This survey was intended to cover all numbers affiliated with the FASFID, but out of the 98,000 questionnaires dispatched only 24,500 were returned, 22,700 of which could be used for statistical purposes. The large number of questionnaires remaining unanswered in spite the organisation which carried out the survey and the type of personnel concerned, is noteworthy.

(2) Translated as "graduate engineers" throughout this paper although British and American standards are not always comparable.

(3) Fédération des associations et sociétés françaises d'ingénieurs diplômés.

comprehensive inventory of the stock of graduate engineers, which can be broken down by types of training between a number of major [illegible]tors. On the basis of the FASFID brochure of December 1965 together with the list of affiliated associations and their membership (according to the "Boulloche Report" "the average rate of support is 80 per cent [illegible] for certain colleges, over 95 per cent of the alumni continue to subsc[illegible]e to their association"), the following table may be compiled.

Sector of activity according to type of training	Number of colleges	Number of former students	Number as a percentage
1. General training	11	30,869	27 [illegible]
2. Agriculture and industry . . .	7	9,133	8.
3. Energy	4	11,850	10.
4. Mining	4	5,625	4.[illegible]
5. Building and civil engineering .	4	6,655	5.9
6. Metals	22	37,159	32.9
7. Chemicals	13	10,459	9.2
8. Textiles and leather	1	696	0.75
9. Other industries	2	715	0.85
Total	68	113,161 (1)	100.00

(1) In December 1965 FASFID grouped 72 associations with an overall membership of about 120,000 certificated engineers.

Although such a table indicates how varied and comprehensive are the types of training and gives the relevant stocks of graduate engineers, it does not show how graduate engineers are distributed among the various occupations. This aspect might be ascertained through a systematic and regular perusal of the yearbooks published by engineering schools, a project fully warranted by the leading position held by engineers in the ranks of highly skilled scientific and technical personnel. From the yearbooks of alumni published by each of the 138 establishments authorised to award engineering diplomas (1) information was obtained enabling such personnel to be classified according to four criteria:

1. Geographical criterion: a breakdown according to place of residence. The above-mentioned FASFID survey for 1963 shows that 47.5 per cent of engineers were employed in the Paris area (compared with 43 per cent in 1958).

(1) This figure includes the specialised schools which award degrees to students already holding an engineering diploma.

2. Demographic criterion: a breakdown of engineering students and practising, inactive or retired engineers by age group. Engineering careers would thus be followed through, and useful information for framing training policy be obtained. The educational authorities have every incentive for determining the age-group of engineers. In certain categories (e.g. mechanical engineering), the average age is high, requiring a high average rate of replacement. Thus, assuming that overall requirements for mechanical engineers do not increase (the present stock is in the region of 20,000) the annual yield from schools would still have to be some 2.5 per cent of the stock, or 400 to 500 graduates. Inversely, for such a demographically young category as electronics engineers, for example, practically speaking the schools would have to be closed down were requirements not to increase (there are admittedly no grounds for such an assumption). In this case, there would, in view of the average age, be no need for replacement and, in view of the economic situation, no need for expansion.

3. Pedagogical criterion: each school has its own training programme, and in certain cases a special approach to it. The classification by line of study illustrated in the above table is an instance of this criterion.

4. Occupational and grade criterion: a breakdown by sector of economic activity and grade of post. Information compiled according to this criterion would make it possible to determine economic requirements and adapt engineering education accordingly.

Such a use of school yearbooks however requires improved and standardized presentation. The design and content of yearbooks would have to be systematised. A few summary statistical tables drawn up along standard lines corresponding to the four criteria listed above might appropriately be added.

General surveys

Reference has been made to three previously conducted surveys and to the possibility of a "permanent" survey of covering some fraction of skilled scientific and technical personnel. This review of methods for determining the occupational pattern of employment might be completed by describing a survey project and possible source of information covering the entire active population.

In 1963, INSEE (1) carried out a "Survey on training and occupational skills", which has now been almost completely analysed. The main findings are shortly to be published in the review "Etudes et Conjoncture". This survey covers a sample of about 27,000 persons. Its interest from the current aspect is that links can be established between the type of training received and the job held, just as the surveys referred to above show, in varying but relatively comparable categories, the economic sectors in which scientific and technical personnel is employed and

(1) Institut national de statistiques et d'études économiques.

the kind of function performed. In this connection the INSEE enquiry repeats in greater detail the questions asked in the course of the 1962 census. One relates to job status at the time of the survey. The middle and top grades are asked to indicate their principal duties according to a key containing six headings: (1) administration and general management, (2) commerce and sales engineering, (3) production, manufacturing, maintenance, methods, control, (4) scientific and technical research, (5) education, (6) other functions. Questions also relate to educational background and to vocational training. The nomenclature proposed is extremely detailed and should make it possible to trace very precisely the school, university and occupational profits of the persons included in the sample.

With the same end in view, it has been suggested that a kind of permanent inventory should be maintained showing the training and employment of the male population in France by reference to the files of the Military Recruitment Service. In order best to assign young men called up for military service, the Ministry for the Armed Forces needs to know the intellectual and occupational capacities of each conscript. Finding this out is one of the tasks of the armed forces' selection and screening centres. Among other things the Military Recruitment Service maintains records of the general level of instruction and occupational training of every Frenchman upon recruitment or induction. After demobilisation until the age of 60, changes in home address, occupation or place of employment are recorded. Where such questions are concerned, National Service Order 59-147 of 1959, which came into force early in 1964, should correct any deficiencies resulting from omissions by servicemen. The Order thus requires (Section 25) that any changes in civil status, place of residence and occupational situation must be reported. Updating of the files is provided for under the Order and Decree 646,522 of 5th June, 1964, describing how declarations should be filed with the Recruitment Service and by ex-servicemen, and requiring confirmation by employers. Sponsors of the system as a permanent source of economic information consider that the files could be quite easily kept up to date with a minimum amount of co-operation between the Recruitment Service, Social Security and the Ministry of Labour. They also claim that arrangements for a permanent check of this kind would entail no substantial increase in expenditure (between 2 and 3 per cent of the budget for the Army Data-processing Service). They also point out that in the very near future all young people will pass through the armed forces' selection centres, enabling an entire given age group to be kept track of and followed through to the age of 60. With computers gradually taking the place of the data-processing centres, the main users of the information could help in compiling readily available statistics adapted to requirements. As is often the case, economic and social information would thus be a by-product obtained from institutions originally designed for quite other purposes. At first sight this suggestion seems well worth considering; so far, however, some reluctance is apparent on the part of both the Military authorities and INSEE.

In any event, a better knowledge of the present situation, however acquired, is no more than a starting point. If the aim is to match the yield from the educational system more closely to economic needs, it is these which must be assessed with greater accuracy.

2. Forecasting the future pattern of employment by occupations

To begin with, the forecasting process would probably be facilitated by improved methods of data collection and dissemination, although attempts to determine future employment trends are likely to meet with varying success, depending on the economic sector. Another crucial problem is the impact of technological progress on employment and the occupational structure.

Forecasting procedures

Forecasts, of course, are invariably based on the observation of past trends and a sound knowledge of current conditions (i.e. the recent past). But it is not sufficient to extrapolate past trends. It will thus be remembered that the Manpower Committee used a dual procedure: linear extrapolation followed by corrected extrapolation. How can this correction be made? The simplest and presumably the most logical way, much more in the nature of a practical expedient than an elaborate forecasting technique, is to ask the users themselves what they believe their manpower requirements are likely to be.

This method was used by the UIMM survey, in which firms were first asked to indicate "their immediate needs, as far as possible defining an ideal distribution of their engineering and executive grades according to post and training", and secondly, their "requirements for the various posts, in the event production were to increase by 25, 50 or 100 per cent". The Study Group headed by André Boulloche similarly asked each firm "other conditions being equal, what situation would ideally meet its requirements" (Report, page 14). In this case, as with UIMM's first question, it is rather the devising of an ideal type of distribution than forecasting which comes into play. Yet the fact remains that forecasts will ultimately be made in the light of the object desired, and the surveys should therefore be completed along the lines of UIMM's second question, by asking firms to specify how much they consider production is apt to increase over some given future period. With this proviso and subject to the limitations this type of question entails (see below), it would be of value to investigate manpower requirements periodically among a representative sample of enterprises, rather in the manner of INSEE's survey of business conditions which regularly appears in "Etudes et Conjoncture" under the title "Perspectives des chefs d'entreprise pour le semestre...". (Business outlook for the six-month period ending...).

The Manpower Committee followed a somewhat similar procedure in correcting linear extrapolations of manpower requirements by occupation. The vertical committees of the Plan were asked to supply their own forecasts of employment by occupational categories. It was pointed out earlier however (Part I - Chapter I, Section 2) that the information supplied by the vertical committees is of uneven value. Generally speaking, liaison between the Manpower Committee and the vertical committees appears to have left much to be desired: the informational problem here is one of circulation, of standardized concepts and compilation, and even a largely institutional one of relations between the various research bodies

concerned with planning preliminaries (1). At the same time some people fear that such corrections to linear extrapolations may be more or less intentionally prejudiced. They point out (2) that "the forecasts by the vertical committees are based mainly on data supplied by employers; while possibly handicapped by manpower shortages they are by no means inconvenienced by surpluses, and are therefore apt to overestimate their labour requirements, by allowing for example, for only a small increase in productivity to obviate any danger of shortage". Such a view-point is debatable, and it may be argued instead that employers, at least where highly skilled personnel is concerned, think in terms of recruitment possibilities rather than recruitment needs, and so fail to define their real requirements. By recruitment possibilities is meant both the supply of certain types of personnel, and the largely associated question of the remuneration they demand. The vertical committees have in fact been criticised for such an attitude.

But even if an effort is made to guard against this real or alleged tendency, and if the forecasting problem is more uniformly approached by the vertical committees, knowledge of future manpower needs is still bound to vary considerably as between sectors. The Report by the Second Manpower Subcommittee points out that the validity of forecasts by the vertical committees differs according to the types of occupation considered. "The materialisation of manpower forecasts closely depends, or certains categories, on the economic policy pursued during and after the period covered by the Plan. It is therefore highly important that forecasts should be consistent with the resources which the authorities are actually prepared to earmark for relevant expenditure". Forecasts are not influenced by public investment alone: the nature of the activities must also be taken into account. We have already said how hard it was to forecast needs in certain important tertiary activities. Thus the trade also points to the difficulty of forecasting requirements for engineers and senior technicians in civil engineering and construction. It is impossible, they say, to forecast needs in other than the main structural work, ventilation, central heating, roofing or plumbing being examples. This is mainly because it is difficult to know just what work is likely to be called for in the longer term, especially since the main weight of building demand shifts between new building and maintenance work.

In view of these difficulties and limitations, some feel that an empirical knowledge of requirements by consulting users is not enough, and that it should give way to or at least be eked out by a more scientific approach. A better understanding is needed of factors influencing employment and of the employment pattern. One is economic growth, which modifies the volume and structure of final demand. In planning, growth is normally taken into consideration as a target factor. Assuming the technical coefficients to be constant, that is to say lacking any technical improvements, by means of a table of inter-industry transactions (input-output table) changes in manpower requirements brought about by economic

(1) It should however be noted that the Manpower Committee sent observers to meetings of the vertical committees.

(2) H. Hatzfeld and J. Freyssinet: "L'emploi en France", Editions Ouvrières, Paris 1964 - p. 208.

growth in the different sectors can be calculated (1). Actually, however, it is impossible to work without assuming some rate of technical progress or some average rate of increase in productivity applying to the whole of the economy.

Technical progress and changes in the occupational structure

One of the fields where improvements to the information process are recommended by the Manpower Commission is "the study of relationships between employment pattern trends and technical progress", mentioned in the conclusions to its Report.

Specialists agree that this is a highly important analytical aspect of manpower needs. Mr. Vermot-Gauchy mentions various unpublished studies carried out between 1956 and 1958 by the former "Commissariat à la Productivité" covering several branches of industry (2). These studies enabled trends in output to be empirically linked with trends in the numbers needed to achieve the particular output. Curves can thus be plotted showing the variation in the labour input per unit of output - the inverse of the productivity coefficient - in relation to the growth rate of output. The author however notes that the ratio, which varies from one sector to another, also varies over time within a particular sector. "Forecast curves other than those observed in the past must therefore be plotted, or, better still, factors included in the growth model likely to cause a shift in the curve pattern. But this cannot be done without first studying possible future changes in the technological environment, and without quantifying the foreseeable effects of such changes on the relative position of the curves". Changes in the technological environment are commonly described as technical progress, which, it may be argued, cannot accurately be predicted. Thus according to Jacques Wolff (3) "so far it does not seem possible to forecast technical trends accurately, to determine the exact time needed to develop an invention, or to assess the effects of replacing the capital equipment used by some other type". With this as a starting point it is easy to see why such a sequence as technical progress - productivity - employment - occupational structure should be difficult to define in forecasting terms.

So far as the techniques of forecasting are concerned, the operational procedure, as B. Grais has clearly shown (op. cit.), is relatively simple. We already know that, by introducing new production processes or by modifying former processes through organisation, rationalisation and automation, technical progress causes the production-factor combinations to change. By this we mean that changes occur in needed quantities of the various factors and in the proportion in which they must be combined

(1) These points and those discussed below are examined in detail in the previously mentioned report by B. Grais, pages 13 to 19.

(2) op. cit.

(3) "La Prévision", coll. l'Administration nouvelle, Berger-Levrault, Paris 1963.

to produce a unit of output. One of the factors is manpower. Technical progress hence causes the numbers needed in each occupational category to produce one output unit to change. The occupational structure required for production accordingly changes.

By referring to planning targets, it is possible to predict final demand for the output from each sector of activity, and by using an input-output table (which, it is true, does not cover the entire active population), to predict the impact of final demand on other sectors. Consistent forecasts of production changes in the various sectors can accordingly be made. The next step is to predict the impact of such production changes on demand for the different factors, and more particularly for labour. Labour is not a homogeneous factor, since it is made up of different occupational categories, so that both the variation in overall requirements for each sector of activity and changes in its occupational pattern must be forecast.

Omitting such questions as variations in the number of hours worked and possibilities of factor substitution (as between labour and capital or as among occupational categories) the major informational problem evidently consists in obtaining a better knowledge of trends in productivity and especially in occupational coefficients. These data are of course needed for each individual industry.

The analysis of technical progress extends over a vast area, and the most common approach is to rely on a knowledge of past trends rather than on forecasting data. If the objective lies in raising output - which is part of planning - how far this can be achieved through a higher productivity rate must be ascertained, while productivity growth will depend at least to some extent on a higher output rate. But owing to the present state of knowledge it seems very difficult to predict influences on the occupational structure. There is no justification for inferring that the future impact of technical progress on the occupational pattern in some given industry is bound to be the same as in the past. Technical progress can take many forms: whether in materials, production methods and plant, or in the organisation of directly and indirectly productive activities. It may even lead to the emergence of new professions, such as those of analyst and programmer with the increasing use of electronic computers.

Automation and the introduction of automated processes are subjects which have been widely written about in relatively recent years. Although automation failed to sweep everything before it, as at first feared by some, it is still difficult to tell how long it will take to become a force in the economy. In the recent past its growth has been uneven, since this is largely dependent on general economic conditions as well as on the size of firms and the market. So far as effects on the occupational structure are concerned, it is difficult to define any straight-forward trend. While a rise in the proportion of technical, engineering and managerial grades can generally be noted, the rate varies form one industry to the next and some sectors may even be by-passed altogether. It is significant that in the United States, where automation is most highly developed and where its consequences have been most closely studied, the Department of Labour's Commissioner of Labour Statistics should recently have written that "the overall patterns of employment seem to demonstrate that technology as such, even apart from other factors, is

operating to raise skill levels generally. My own judgment is that, on balance, the trend of skills is upward, but I do not have the analytical data with which to answer this question with certainty". (1)

In view of the inadequacy of our present knowledge regarding the influence of technology on the occupational pattern, the specialists suggest the use of largely empirical forecasting methods to identify the areas where the information process might possibly be improved. The essential feature of the procedures proposed is to compare firms or economies at different levels of productivity. The report by the Second Manpower Subcommittee says that "in the present state of statistical information it has not yet proved feasible to make valid forecasts of the occupational structure of employment through recourse to such methods as ... a comparative study of the employment pattern in the most productive and least productive firms belonging to a same branch". The 1963 industrial census, although containing information on the employment pattern in each sector which would enable the most productive and the least productive firms to be compared, has not been used. Admittedly it is difficult to make any positive identification of the firms which are most productive. Above all, there is no evidence to show that those which are least productive will necessarily move forward in the same way as the firms farther ahead, nor that their personnel patterns will develop along the same lines. Progress of productivity will in fact largely depend on plant facilities used. Thus, when a firm five years behind another renews its plant, it will hardly be the type used by the more progressive firm five years earlier.

True, the objection loses force when the comparison applies to the same sector in two different countries that have not reached the same technological stage. The Second Manpower Subcommittee has attempted such a comparison. It was however used as a means of testing the accuracy of its own forecasts rather than as a reliable method for making others. On considering recent employment trends in the United States, it thus came to the conclusion that the heterogenous character of job classifications was a major obstacle. As a method of obtaining information, international comparisons must therefore be used cautiously, and broadly similar types of organisation in the countries concerned are called for.

There still remains one empirical method which the second Manpower Subcommittee wished it had been able to use. This is the systematic identification of manpower shortages, which might be presumed to be effective in determining desirable patterns of employment. Shortages can in fact constitute a means of assessing requirements. The question however arises whether they constitute a valid forecasting tool, since they define requirements under present rather than future organisational and production conditions. On the other hand analysis of shortages can

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(1) E. Clague: "Effects of technological change on occupational employment patterns in the United States" in the OECD report "The Requirements of Automated Jobs", North American Joint Conference, Paris 1965, Supplement page 117. The same impression is gained from other contributions to the same Conference. It is also confirmed in studies by Pierre Naville on the metallurgical industry in France. See in particular "L'automation et le travail humain" - a survey report published by CNRS in 1961.

help towards a better knowledge of the training-occupation relationship, a necessary step in proceeding from forecasts of manpower needs to the formulation of a more appropriate training policy.

B. The training-occupation relationship

In theory, once manpower requirements by occupation are known, all that is needed is for the personnel for each occupation to be trained within specific time limits and in appropriate numbers. In practice however, even in the case of scientific and technical personnel, the type of training suited to each occupation can be defined only with difficulty.

The subject is now one of considerable care and concern, and two separate steps appear to promise some improvement of the information process. The first is to find out how highly skilled scientific and technical personnel is distributed throughout the economy, by determining not only the type of job which is held but, more important, the extent to which it meets user requirements. After this first examination of the actual links between training and occupation, the second step is to re-assess the occupational concept from the aspect of training requirements.

1. The qualitative adaptation of supply to the demand for skilled personnel

According to the Report by the Second Manpower Subcommittee "imbalances on the employment market for skilled manpower are rarely apparent, and in the final analysis the demand for skilled manpower closely corresponds to the educational supply. But while the output from the educational system largely determines the occupational pattern of the active population, its failure to match the manpower requirements entailed by economic and technical growth leads to a tight supply of certain categories of personnel, and makes it difficult for some graduate personnel to find employment and adjust to the market". Growth is seriously hampered to some as yet undetermined extent by the failure to equate the output of the educational system to the economy's needs, resulting in inflationary pressures and the under-employment of resources, and ultimately adding to the cost of development.

One purpose a better knowledge of such latent or hidden imbalances could serve is to ascertain shortages or surpluses of certain types of personnel, and so make it easier to forecast manpower needs. But a knowledge of latent imbalances should primarily be used to determine the degree of maladjustment of training to the job and of the job to training, even though the demand for job qualifications shows a marked tendency to match the skills of the personnel available. The question at issue is how the skills acquired through training match the duties of the job.

How far does training match requests expressed in terms of the skills required for effective performance of the job? Information on this question might be obtained by means of additional surveys at national or regional level broken down by type of training and type of job. Two sorts of surveys might be attempted, one among users and the other among personnel employed.

Surveys among users of scientific and technical personnel

The question to be ascertained is whether employers regard the personnel they employ - from the aspect of training assessed in the

terms of the ability to exercise a certain trade - to be entirely fitted for the tasks assigned. This is equivalent to an assessment of how far training goes to meet user requirements. At the same time a critical analysis of such user requirements may not be amiss in an attempt to evaluate their degree of relevancy.

Are employers qualified to determine objectively just how far the type of scientific and technical personnel available goes towards meeting their needs? To begin with, this would mean that they are capable of defining the duties pertaining to a given job and the occupational skills required as they strictly relate to a specific type and level of training. Any given job, regardless of skill level, of course calls for the performance of certain specific functions based on various intellectual, psychological or material criteria. These in turn can serve to define the content of a certain job qualification. Can this be set against some specific type and level of basic training, supplemented perhaps by a certain amount of practical experience? On the assumption that such a rigid relationship between training and some occupation could in fact be established, a conclusion that might be reached is the absence of the type of training needed, implying that the content of the present training courses makes them unsuited to requirements.

True, there may be alternative channels of specialised training providing access to a same occupation, as evidenced by the vacancy notices in newspapers. Not uncommonly, an identical job may be offered to candidates with a fairly similar level of education acquired through an entirely separate process of specialised training. Hence no one single link necessarily exists between a specific occupation and the training required. Just how far the different kinds of training for a given job can be interchanged must however be considered. The importance of this question becomes apparent when the positions held by people who have acquired their training by such less formal methods within the firm, by private study, on the job or even in related occupations are considered. Thus occupational experience or private study enables a number of workers to improve their skills and satisfactorily perform tasks for which their formal education has not sufficiently prepared them. The UIMM survey as well as the "Boulloche" Report both draw attention to the large proportion of so-called "self-taught" engineers and other senior grades although in fact most are self-educated only in part. Both the UIMM and Study Group surveys put the figure at more than 40 per cent.

It is, of course, difficult to interpret this percentage altogether satisfactorily. In all likelihood it points to a shortage of personnel possessing the type of education considered entirely suitable by the users. Thus when the Boulloche Study Group asked a limited sample of firms which method of training they preferred, the result showed a substantial fall in the percentage of self-taught. The replies however indicated no desire that this percentage should fall to zero. Here, then, we have an alternative educational process, even though the relevant personnel may not be regarded as an ideal substitute. Some users, in fact, set a high value on job experience or on the enterprise shown by personnel who seek to improve their knowledge by private study, often under difficult conditions. Others appreciate this type of personnel for social reasons, or perhaps because it is less demanding where wages are concerned.

This last consideration calls for the remark that users cannot objectively assess the adaptation of personnel to their requirements when influenced by factors which, while perhaps important in themselves, are

but subsidlary where training is concerned. Thus the notion of job skills, which logically are measured by reference to a sum of knowledge and qualifications required for the performance of specific functions, is frequently approached from the angle of wage scales set by collective bargaining agreements. This being so, when certain qualifications are required of an applicant, the question is whether they are essential to the job or represent a tactical move in connection with remuneration. In the latter case the skill from the employer's point of view would be a criterion for selection at a certain level of remuneration not directly linked to ability. From the wage earner's point of view, on the other hand, a certain level of remuneration would seem to imply recognition of a certain level of skill.

This first point leads to the more general question whether the requirements of users of scientific and technical personnel are reasonable. Only if they are can an objective basis be presumed to exist for assessing how nearly the supply of personnel is equated with requirements. But the employers' judgement in this matter may be too subjective to be reliable, owing to the intrusion of considerations which are open to question from the standpoint of personnel efficiency alone. Such a judgment is based on the extent to which the personnel employed conforms to a pattern the employer regards as best meeting his needs. How is the "profile" of a candidate for a job determined from the standpoint of intellectual ability, knowledge, character and psychology? Usually both objective and subjective elements will be observed to make up such a profile, including requirements inherent in the nature of the job, preferences arising from the esteem or prestige attaching to certain types of training, and others deriving from the intellectual and academic background of the user himself. The psychological bias in formulating requirements applies especially to engineering executive and senior technical grades.

If the validity of certain user requirements can be questioned on the grounds of largely subconscious motives, some of the requirements laid down for a position will not really be necessary. We shall leave aside any deliberate restrictions imposed on the access to certain professions or job duties - which may be described as Malthusian symptoms of a newer type of corporative approach. But in certain jobs, are the specifications which relate to the level and type of training, the number of years of experience in the occupation, and age limits objective necessities or simply a method of screening the applicant? In the latter event, do they not further widen the gap between the demand and the supply? If so, in assessing how far the supply meets their needs, cannot employers be hamstrung by their own requirements? One of the consequences may be to compel some users to pay what they consider to be abnormally high wages in order to secure personnel they look upon as adequately qualified. True, the salary criterion, as assessed from outside by means of statistical data, provides no way of determining whether unreasonable qualification requirements or genuine shortages of skilled personnel are the responsible factor. In France, it has thus been noted that between 1954 and 1962 remunerations in the higher and middle grades rose in relation to the average annual wage. Putting the annual average wage for all activities at 100, the index in relation to the annual average wage went up from 340.9 to 350.5 in the higher grades, and from

164.4 to 168.9 in the middle grades (1). In any event, whatever the cause, a rise in wage rates shows evidence of an imbalance between supply and demand.

In contrast with such inordinate requirements, it may be argued that some job specifications are expressed, as has previously been suggested, in terms of what is possible rather than desirable. Users' attitudes here serve to conceal some of the gaps between supply and demand. For example, is the demand for personnel expressed in terms of qualifications because they correspond objectively to needs, or because the employer merely seeks the types of skill which he knows to exist on the market? Is it expressed in terms of objective needs relevant the occupation or by reference to the level of remuneration prevailing n the market for a specific level and type of training? The consequence for the labour market may be that, rather than let production capacity lie idle, users will have recourse to personnel which is available but unsuitable. As a result, productivity will be lower than it might be. Balance is lost because jobs are held by people lacking the necessary qualifications. Sometimes the workers are underskilled, although experience in the occupation and possibly further training within the firm will enable some to acquire additional qualifications, as denoted by the example of "self-taught" personnel. Sometimes, on the other hand, overqualified staff is used, either owing to an inadequate supply of personnel with the required degree of skill (e.g. an engineer doing the work of a technician), or because certain firms, generally those in the field of advanced technology, hoard highly skilled staff to have them on hand when business conditions are right or to avoid losing them to competitors; or, again, because the firm has neither the organisational nor technical facilities for making optimum use of their highly skilled personnel.

Surveys among users undoubtedly offer wide scope for investigation, enabling the information process to be improved and the supply of scientific and technical personnel to be thus better equated with the needs of the economy. At the same time, surveys might well be undertaken among the actual recipients of scientific and technical training.

Surveys covering scientific and technical personnel in employment

The organisation of the principal levels and types of training is based on the assumption - supported to a certain extent by events - that openings exist in conjunction with corresponding skill requirements. The aim here should be to add to and periodically revise previous information by surveying trends and by polling opinion. Two main subjects might be chosen for enquiries among personnel in employment. First, openings actually offered by the economy for each type of training, and secondly, regardless of the job held, the extent to which training is used in the occupation.

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(1) J. Begue: "Elements d'analyse de l'évolution de la masse des salaires de 1954 à 1962", in "Cahiers de l'ISEA", Serie AB, 5 - 162, June 1965, page 137.

Openings actually existing for each level and type of training can be ascertained through surveys of employed personnel alone. Such information can moreover be of considerable value to educators, who frequently have little or no knowledge of the fate befalling those they have trained to teach. It is of course possible in some instances, for colleges of engineering, for example, to refer to yearbooks, but no full use is made of this facility and all skilled scientific and technical personnel are by no means covered. Openings should hence be more intensively investigated, and a standard definition of those which correspond to a certain type of training attempted.

The problem of existing openings is in fact a dual one. To begin with, openings at the end of a specialised training course should be ascertained. As organised in France, post-secondary education requires that personnel graduating from establishments to which entry is limited by competitive examination or by some other method of selection be distinguished from personnel leaving establishments which are freely accessible provided the "baccalauréat" was passed upon completing secondary education. This is hardly the time and place to discuss the particular features, defects and merits of a system in which some educational processes entail a ruthless selection upon entry (1) and few losses upon departure while others are marked by overlax rules of admission and an alarming proportion of drop-outs during the course. But the system cannot be disregarded when available openings are being analysed at the end of a specialised training course, since it almost inevitably leads to two categories of trained personnel being retained the first a "custom-made" product of an educational process almost automatically providing employment opportunities and the second a more ambiguous, less homogeneous product of a process offering indeterminate, hazier outlets. In France, graduate engineers and doctors of science are thus regarded by the industrial user as homogeneous products (from the professional more than from the human standpoint) which are relatively easy to equate with some specific professional activity. Science graduates (at the lower "licence" level) however are regarded as "mass-produced" and of uneven, ill defined quality. The industrial user is apt to criticise their inability to establish satisfactory human relations, their narrowly industrial outlook, their lack of respect for hierarchy, etc. It is somewhat disquieting, in the face of present employment opportunities, and the approach now used by employers in matching personnel with requirements, to note present attempts to channel an ever greater percentage of students towards science. The increase will for the most part affect the Science Faculties and not the schools

(1) The choice of candidates is determined not only by competitive examinations but by conditions of admission to the preparatory classes. Admission is determined by criteria other than those productive of adequate and even outstanding results in the "baccalauréat" examination. As the Minister of Education pointed out recently in his reply to a written question by a Deputy: "To be admitted to the preparatory classes pupils must give evidence of quite exceptional talent in the subject, show unusual intellectual attainments, marked ability to organise, analyse and pick out the essential facts, and a capacity for rapid and accurate comprehension", ("Journal Officiel" of 15th April, 1966).

holding competitive entrance examinations, where classes generally grow rather slowly. Thus means a higher output of "mass-produced" than of "custom-made" personnel. The Boulloche Report points to the extremely small proportion of engineering and managerial jobs held by science graduates at the "licence" level: less than 3 per cent, whereas the number of science degrees awarded each year almost equals the number of engineering degrees (1). Thus in 1962, 6,133 engineering diplomas were awarded, including those awarded to foreigners (330), or 5,355 if the 778 awarded to post-graduates are discounted. It may be added that 437 were also science graduates. During the same year 4,875 science degrees were awarded, 2,874 of these to prospective teachers. In 1963 the figures were 5,448 and 3,444 respectively.

But, as mentioned, the problem of existing openings is a dual one. Our second task should be to analyse openings in terms of career prospects. An attempt might well be made to see how opportunities evolve in the course of working-life, so as to identify typical careers which follow a given training. One possible method would be to conduct surveys of persons belonging to different generations. While not an ideal procedure, since the content and characteristics of a given training may vary over time - particularly of the scientific and technical education now being provided - it is a practical one, owing to the evident difficulty of following the same set of individuals throughout their career.

It would be interesting to find out from such surveys whether inequalities of access to professions and to jobs which are considered suitable in the light of training received tend to persist, increase or disappear. In other words, does the distinction between "custom-made" and "mass-produced" prevail throughout the career of the personnel concerned? Or do other factors instead serve to attenuate the initial sharp separation of the two types of post-secondary training earlier discussed?

Another question to be investigated is whether or not workers with a certain skill at the outset are always used in the jobs for which they have been trained. Can any anomalous use of skills be found, whether through prejudice, the user's ignorance of the most appropriate types of training, or the unwarranted continuation of some initial advantage ensuing from the training received? The previously mentioned FASFID survey describing the status of graduate engineers in 1963 shows 11 per cent engaged in work quite unrelated to their education. In the absence of any basis for comparison, it is impossible to form any hard and fast conclusion concerning this percentage, and conceivably a similar or even higher proportion would be found for personnel from other educational backgrounds, whether or not of a scientific kind. There is, however, one question which has periodically been touched upon in France without ever being thoroughly investigated. This is what might be

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(1) Figures are quoted from the following sources. For engineers, a restricted publication: BUS. Annexe Statistique, October 1963: "Statistique des diplômes d'ingénieurs délivrés en 1962". These are the most recent data available. For science graduates the "Informations statistiques" of the Ministry of Education: for 1962 Nos 60, 61, June, July 1964, page 287, for 1963 (the last year for which information is available) Nos 74, 75, October, November 1965, page 479.

called the misemployment or misuse of scientists. In specialised training processes almost automatically giving access to employment and where entry is subject to competitive examination, prospective students are required to possess considerable mathematical ability and a certain turn of mind. Mathematics are even said to have become the Latin of higher education. By this is meant that mathematics are now the "open sesame" to the most highly sought-after post-secondary channels of education, just as Latin was for many years and to some extent still remains the discipline which governs access to the secondary courses in greatest demand. It is not the situation in itself which should be criticised; an educational system based on selection also calls for certain selective criteria, which admittedly can never be entirely fair. But if reference is made from time to time - sometimes by the scientists themselves - to the misemployment of scientists it is because the courses of study involving selection through competitive examination open the way to the so-called topflight careers. Here, however, as time goes on, the professional duties performed are apt to become increasingly divorced from the educational background, particularly one of a scientific kind.

It is well known that the engineer who looks no further than the production or research department of a firm has practically no chance of reaching the uppermost levels of the hierarchy. All this may strike one as perfectly normal, since, once again, criteria must be used to pick the most gifted individuals. However, the question of misemployment of scientists arises once the fact is recognised that a limited number of persons are suitable candidates for a scientific education. A bottleneck that has cramped the French economy on various occasions is the shortage of highly skilled scientific personnel. Recent efforts to develop a comparatively independent electronic-computer industry or the use of nuclear energy for both military and peaceful purposes have, it has been alleged, in part been hampered by a dearth of physicists and mathematicians. Perhaps, however - an argument which might well be supported by the type of surveys here described - the bottlenecks are made even narrower farther up the line, owing to a concept of entrance examinations which has its Malthusian side (1), and down the line by the drain of

(1) Alfred Grosser ("La France malade d'examens", in "Le Monde", 4th April, 1966) was not thinking of scientific education alone when he stigmatised the attitude of several Boards of Examiners, who point to the shortage of gifted candidates and the desirability of maintaining a "normal" proportion between the number of candidates and the number selected. "But" - he writes - "is this the only factor considered? The narrower the gate to paradise, the greater the prestige of today's elect will be, and the greater is bound to remain that of yesterday's. So the economy needs more engineers? But if there were more than one "Ecole polytechnique", how could such a select body of graduates be distinguished from all the others? We hear of the failures such as the two or three unsuccessful attempts that have made people understandably bitter for the rest of their lives. But whoever hears about all the talent wasted because the barriers set up at the end of the preparatory courses discourage any attempt to increase their number, the outcome being that the many generations coming up behind are held back by ever more rigid requirements".

scientific personnel into administrative or other work unrelated to their educational background. It is difficult, moreover, to assess this latter trend, since the most serious shortages occur among scientific research personnel: the career of a research scientist is generally assumed to be very short (the end is put at 35 years of age in basic research and between 40 and 45 in development research), while such research staff can then hardly be put on the retirement list.

To accompany this analysis of the training and occupational relationship, an attempt should also be made to assemble reliable information concerning the relationship between type of training and the amount of annual income at the different stages of active working life. How far trained personnel matches up with requirements could be tested by finding out the educational processes for which the position of the graph over time is much higher than that of average wage rates and trends. The suspicion may then well arise that in certain cases shortages are systematically maintened and, consequently, judgment be made in economic terms on the educational system itself.

To complete this very detailed study of employment opportunities, the extent to which qualifications acquired through training are actually used in the post might advisably be considered - though this is a field in which it is extremely difficult to obtain valid information. From the user's point of view, imbalance is qualitative when the personnel available has not had the training matching the qualifications which the user rightly or wrongly considers to be needed for effective job performance. Personnel employed may instead feel that there is a lack of adaptation between the supply of trained manpower of which it is a part and the demand as measured by the tasks actually performed in the post. Although opinions may be difficult to formulate on this question, and ill lend themselves to objective interpretation, the survey procedure might consist in asking personnel how far their training can be equated with the duties of their particular post. A few questions might be as follows:

- Is the training received necessary for the efficient performance of job duties?
- What use is made of the knowledge acquired: a great deal, little, none at all?
- Are certain intellectual and social patterns of behaviour developed by the training received relevant to the position held?
- Does the subject feel that, apart from the question of remuneration, he is occupationally over-qualified for the job held, that is, that poor or insufficient use is made of his abilities?
- Does the subject consider that the knowledge he acquired during the formal period of his specialised training is rapidly growing out of date? Does the training received enable him to adapt himself or does he consider his job and opportunities for promotion threatened by younger people?

To sum up, a great deal of light could be thrown on the problem of bridging the gap between training and occupation by means of a critical examination of the existing links. Presumably the forecasting approach to the training-occupational relationship would then be made easier.

2. The concept of occupation from the standpoint of education

The basic principle of educational planning in terms of economic needs is to provide an appropriate number of persons with the sort of training that will enable them to perform as effectively as possible the jobs offered by the economy. These jobs are generally grouped into occupations: from the standpoint of the qualifications required of those engaged in them, these may be defined according to a type of specialisation and level of training. In practice, however, it is extremely difficult to work out a definition which will identify each occupation with a given type of training, and this constitutes one of the stumbling blocks in adapting education to economic needs. Whether one approaches the problem from the training or occupational aspect, with nomenclatures of occupations as they are at present, no satisfactory link can be established.

The training-occupation relationship

From the training side two main points emerge. The same type of training provides access to a number of occupations, and a specific occupation may be carried out by persons with different training. Both these aspects, and particularly the second, bring out an important factor in the adaptation of training to requirements: occupational migration or transfers. The report by the Second Manpower Subcommittee states that "such shifts may occur at the same level or from one level to the next consistently with the training acquired. But they can also lead to wastage when changes of occupation are incompatible with the effective use of initial training: transfers are then to some extent caused by poor adjustment of the educational system to economic requirements, and they should not be projected in forecasts designed to achieve equilibrium of the labour market".

Leaving aside the latter type of occupational transfer, which was indirectly alluded to when discussing the misemployment of scientific personnel, transfers compatible with previous training manifestly create a problem, since they ought to be taken into account when forecasting requirements for certain types of trained personnel. Hence it is a special aspect of the training-occupation relationship. A certain fraction, difficult to determine, of personnel with a specific type of training would have to be matched to a succession of occupations instead of a single one held over a period of time. This will, in fact, be shown to be a particular aspect of a more general problem. An endeavour should therefore be made to acquire a better knowledge of occupational transfers. The surveys proposed in the previous section to analyse openings in terms of career prospects should be of some help. Research has already been carried out in France on the question, and B. Grais (op. cit.) refers to an employment survey which "takes place every two years for the same dwelling cross-section, supplemented by a sample from new housing. The occupational situation of persons included in two successive surveys is compared for these two dates. Special questions are put to persons not included in the previous sample survey regarding their job on that date. The survey conducted in October 1964 is the third to be carried out along these lines, the same sample of dwellings being used as in October 1962. The earlier mentioned INSEE survey on training and

occupational qualifications also included a set of questions concerning changes in job status over the five years antedating the survey. Finally, Claude Vimont and Jacques Baudot (1), taking a one-in-twenty sample of the 1962 census, studied holders of diplomas in technical or vocational education, mainly from the angle of the relationship between the trade learnt and the one practised, thereby throwing light on one aspect of changes in occupation. This category includes some highly skilled scientific and technical personnel and those who are less skilled. The study shows the extent and diversity of the factors influencing occupational transfers: transfers on the same or to a higher level can be explained both by the economic conditions applying in a particular sector (expansion or recession) and by the specific type of training received, which may or may not give access to other types of occupation. But it is not only prospects in an expanding sector that determine upward job movements; in a declining sector these may also result from a shortage of alternative openings. From the findings of this study it is clearly extremely difficult to identify the main factors causing shifts of occupation, at any rate accurately enough to allow for them in forecasts of future needs. Among the various conclusions reached by C. Vimont and J. Baudot, two may be singled out. One is that in a certain situation no strict connection is apparent between training and occupation "even for holders of diplomas in technical education, the object of which is direct preparation for a job. Once he has gained a certain experience, the worker is promoted to a position where he can use the knowledge acquired during his studies and his first years at work". The promotion may appear to be a change of occupation whereas in fact it is the desirable and to some extent logical follow-up to training. The second conclusion is that "forecasts must set occupational training requirements considerably higher than the economy's actual needs in the various trades ... in order to allow for likely shifts of occupation in the course of the individual's career". On the face of it this second conclusion appears to be sound, but it is a rather surprising one. How can training be matched to needs by systematically allowing for a surplus? Is such an easy way out an admission of failure? Such a conclusion is in fact a powerful argument in favour of a complete rethinking of occupational concept and the classifications based upon it, at any rate when approaching the problem from the training standpoint.

Consideration from the training aspect, then, suggests that correspondence will be achieved by linking a certain type of training to a group of trades taken in the usual sense. This group can be composed of both horizontal and vertical categories. If the question is then approached from the occupational aspect, a similar picture is obtained of a large number of trades with a changing and frequently indeterminate content when compared with training. The definition of occupations or trades owes much to history, and some have been largely institutionalised, whether by custom, law or regulation. The French term "profession" just as "trade" in English, is moreover an ambiguous term, since it applies both to the production units (firms or establishments) and to the functions carried out by individuals within the production units. As applied to a

(1) "Les titulaires d'un diplôme d'enseignement technique ou professionnel dans la population active en 1962", in "Population", n° 5, September-October 1965.

production unit, a "trade" combines a set of activities in which certain common features are dominant (1). These provide the criteria determining to what particular trade the units of production belong (the needs they satisfy, raw materials or semi-manufactures used, techniques applied, stage in the manufacturing process, etc.). Unfortunately the criteria are so diverse that a single production unit may belong in many different categories, making it difficult to define homogeneous groups of trades. The definition of trades as applying to the individual, which is the aspect discussed in this report, seems however in many cases to have been used by reference to the production unit, that is, to criteria unrelated to the activity of the individual. Questions concerning occupational qualifications are in fact frequently handled in the framework of trade organisations, as during discussions of collective agreements. This can lead, if not to confusion, to rigid divisions and an unduly large number of trades as applying to the individual, thus complicating the issue from the training aspect. To this must be added the fact that the nomenclature of occupational categories is not entirely consistent with skill and knowledge requirements, and that, given the rapidity with which production structures evolve, any job classification system soon grows out of date. In short, there is too much of it and at the same time it is not sufficiently adaptable to changes in the economic situation, production and organised trade groups.

The solution therefore, as suggested by Michel Debeauvais (2) is to select a system of classification "which satisfies from the outset the requirements for forecasting manpower needs and for educational planning". This classification should comply with the following criteria:

- "It must be an overall scheme, i.e. apply to the entire population and all the educational facilities, so that the forecasts will be consistent;
- It must be made as simple as possible, so as to quantify only major aggregates, at least initially. To do this a classification scheme must be adopted which complies with criteria both of employment and education;
- It must comprise vertical and horizontal categories suited to the basic patterns of the working population, the educational system, and the economy".

To sum up, to adapt training to economic needs, a system reclassifying occupations is needed that will correspond to the various types and levels of training. A governing influence will be the characteristics of the educational system, and the fact that it would be both unreasonable and inefficient to create too many specialised forms of training. What basis might be used for reclassifying occupations so that they could be defined in terms of training?

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(1) See P. de Calan: "Les Professions", Ed. France - Empire, Paris 1965, pages 27 and 31.

(2) "Methods of forecasting long-term manpower needs" OECD "Planning Education for Economic and Social Development", Paris 1963, page 37.

Towards a redefinition of occupations

Two ultimately convergent methods now appear to be proposed. One consists in defining types of training providing access to several horizontally or vertically related occupations. This is the idea of comprehensive training, which means re-assessing the concept and content of training. The other is to define manpower needs not in terms of occupations too often based on uncertain criteria, but in terms of the content of duties the individual will actually be called upon to perform and by ascertaining similarities of content among traditionally distinct occupations. In the absence of any more descriptive term, this concept may be designated as the occupational function, and is one which requires job content and job definitions to be evaluated and examined.

The concept of comprehensive training immediately springs to mind when the adaptation of education to needs is considered. Is not the best guarantee of adaptation a staff capable of performing several functions, of filling several jobs? In a basic analytical study, Jean Vincens (1) attempts to define just what constitutes comprehensive training and to determine a variety of levels. He notes that comprehensive training should not be confused with general education. "To train someone is to give him the opportunity of mastering knowledge that can be applied". Only insofar as such mastery is promoted can general education be said to partake of comprehensive training. Generally speaking, comprehensive training is such that it enables an individual completing the training course to exercise one of the occupations which the training prepares for. Comprehensive training gives the individual a capacity to exercise several substitute occupations. This capacity may vary in extent, depending on whether any additional training is needed. The occupations may all be on one level, or extend over several levels. Hence comprehensive training would guarantee a better adaptation of manpower to needs and mitigate the effects of erroneous forecasts. But in proceeding from the basic definition of comprehensive training to its actual application, a considerable gap must be bridged. To stick to the case of skilled technical and scientific personnel, in the initial stage such surveys as those recommended among users and employed personnel might well enable types of activity open to each training category to be classified. At a second stage, with the help of the appropriate training specialists, adjustments (to subject content or syllabi, methods or teaching systems, and attitudes) might be studied so as to determine a reasonable range of knowledge and skills relevant to each kind of training. This would provide an opportunity for a dialogue between user and trainer, one which under present conditions is apt to scratch only the surface of things, and which of course should regularly be repeated so that new trends in knowledge and new economic or technical developments can be taken into account.

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(1) "Note de travail sur les finalités de la formation polyvalente" (Working paper on the objects of comprehensive training), Institut d'études de l'emploi, Toulouse. Roneoed paper submitted to the INAS seminar on the Objects of Education, to be reproduced shortly in "Droit Social".

The subject of occupational functions can best be introduced by quoting the recent words of Secretary-General P. Laurent of the Ministry of National Education. "The practice for some time" he says, "was to ascertain the number of operatives, engineers or technicians needed in five or ten years times, or to compute requirements in terms of years of study (how many people with two, three or five years of advanced education would be needed?). The method was an illusory one, since economic needs vary and the length-of-study concept makes little sense. What we really need is to define certain types of training in relation to certain types of activity (1)". This concept is based on the observation that the same occupations occur in an increasing number of sectors (as those of electrician, mechanic or chemist), while seemingly different occupations spring or could spring from the same type of basic training, in view of the knowledge or skills required to practice them. Hence a number of occupational functions recur within a number of occupational structures, although the connection does not always strike the eye. These are the functions which would be identified, defined, and finally translated into types of training.

Stated generally and in the necessarily imprecise terms which limited thought on the subject now requires, the occupational function might be defined as a common set of tasks applying to separate types of activity, and of course as the continuing aspect of performance marking the application of changing techniques. The purposely vague term of "tasks" (tâches) should be regarded as covering physical acts and motions as well as thought processes, or the application of the same collection of knowledge to different human or technical situations.

How should such a definition and analysis of occupational functions be approached? Some amount of research now appears to have been undertaken, in particular by INED. A possible procedure is to work out a logical scheme linking a set of tasks which the usual systems of classification regard as alien to one other. On the basis of studies undertaken for the engineering industry Yves Corpet (2) suggests that occupations should be classified by nature and level of job requirements. Depending on the type of requirement, a difference would thus be made between the people dealing with the materials to be processed, machinery, and paperwork (correspondence, files, bookkeeping, administrative work, etc.) and those outside the firm. Similar requirements will of course occur in branches of activity which bear no relation to the engineering industry. Requirement levels, on the other hand, could empirically be assessed by noting their surface characteristics, on the premise that an individual's appointment to some particular post is no haphazard decision but reflects the firm's desire to make the least unsatisfactory assignment. Information should hence systematically be collected regarding individuals in each post: level of training in terms of type and length of

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(1) "L'électronique au service de la prévision scolaire" in "Le Monde", 16th February, 1966, page 9.

(2) Paper read at the INAS Seminar on the "Objects of Education", which so far does not appear to have been issued in written form.

education, age, minimum age of access to the post, denoting a demand for a certain amount of job experience (which, as need be, can partially be offset by longer formal education). An empirical research method might thus be outlined in three phases:

(i) A definition of occupational functions in some homogeneous sector of activity through recourse to a dual criterion of job requirements both as to type and level;

(ii) A recombination of occupational functions as between sectors through the determination of similar types and levels of job requirements;

(iii) A determination of the most appropriate types of training through reference to the main occupational functions thus defined.

However briefly the subject of occupational functions has here been introduced, it enables the available classifications to be assessed. How the Manpower Committee used the INED nomenclature to classify highly skilled scientific and technical personnel has already been described (Part 1, Chapter II). Five major categories are used: scientists and research personnel; engineers; architects; technicians and technical assistants; and draftsmen. It may be argued that these five divisions, particularly the engineering and technical sections, fail to show the diverse content of the occupational functions performed by such personnel, with nomenclatures apt to be greatly detailed at the skilled-operative level but less so for the higher grades. True, they are aggregated categories. But if the engineering subcategories for example are considered, the actual nature and diversity of functions are still inadequately described. Six engineering subcategories are used: mechanical; electrical and radio; chemical; textiles and agricultural; building and construction; and management consultants and sales engineers. It will be noted that some of these divisions designate the occupation in terms of the production unit (as textiles and building). More generally, the value of combining this nomenclature with a classification by functions such as that used in the Boulloche Report might well be argued.

The idea of occupational functions thus brings us into an area still little explored, and its importance and novelty are attested by its inclusion as a subject of research in the "social and economic development" concerted action programme launched by the Délégation Générale à la Recherche Scientifique et Technique (DGRST), to last throughout the Fifth Plan. The purpose of this research project is to obtain nomenclatures defined as categories used for compiling information, in which "each item would recombine a set of occupations affording relative ease of movement among them, the transition from a less aggregated to a more aggregated nomenclature implying a longer period of adjustment within some particular category". The DGRST however points out that as matters now stand research of a methodological kind must first take place.

This attempt to sum up and analyse the work and research being done in France to equate training with economic needs calls for no particular conclusions. The steps taken as part of planning have been described, as well as improvements to the information process which might possibly be made in this same planning context. No one can be sure,

however, man and the economic and social facts of life being what they are, that an entirely satisfactory adjustment will ultimately be achieved. This is why it should prove so well worthwhile to define the conditions and institutions of continuing education, where, as stated in the conclusions to the School Investment Commission's Report, "almost nothing has yet been done or even planned".

THE RESPONSE OF HIGHER EDUCATION TO ECONOMIC NEEDS

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". . . universities do not exist simply for their own sakes, as daffodils and sparrows and mice do: they have a purpose."
Sir Eric Ashby

I. Introduction

I shall first propose criteria by which a country can identify occupational needs for highly qualified workers and then examine the responsiveness of higher education in the United Kingdom and the United States to some identifiable occupational needs.

Higher educational systems must respond to certain economic requirements. These are:

(i) The training of highly qualified manpower;

(ii) The preparation of leaders;

(iii) Research and development;

(iv) Participation in both establishing and changing values and culture;

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(1) Mr. G.C. Archibald made useful suggestions. Mr. M. Borland, Mr. T. Scheinman and Mrs. L. Folk provided research assistance. I am grateful to them for their help, I have used unpublished material prepared under National Aeronautics and Space Administration Grant NsG-342 to Washington University. None of these is responsible for any opinions expressed in this paper.

(v) Serving consumer demand;

(vi) Serving as a repository of knowledge.

These functions should be performed efficiently. In this paper I emphasise the training function, and treat the other functions only as they complement or conflict with the performance of the first function.

The occupational needs of an economy are related to available capital, level of technology, present distribution of skills, and wants. The first part of Section II states this problem formally and demonstrates that no general solution is possible. Needs for particular occupations can be identified by high and rising economic returns, job vacancies and quality reductions, and departure of actual numbers in an occupation from ideal or desirable numbers. Each of these types of shortage is then analysed. Section III treats various aspects of responsiveness: i.e. how needs are communicated, how the system responds, and the efficiency of response. Section IV describes British and American higher education systems. Section V describes the needs and responsiveness of the American system and examines the occupations of science, engineering, physicians, and teachers in some detail. Section VI does the same for the British system. In Sections V and VI and in each of the detailed occupational sub-sections, the problems of identification of needs, communication of needs, manner of response, and efficiency of response are taken up in turn. Section VII presents the summary and conclusions.

II. Occupational needs

Before we can evaluate the responsiveness of the educational system to occupational needs, we must identify the needs. It is not possible to establish criteria that will satisfy everyone. To do this we require a general and dynamic theory of economic welfare, which we do not have and are unlikely to get.

The occupational needs of an economy depend on the commodities to be produced and the capital equipment available. Obviously the commodity demands change over time and so does capital stock, so that the best occupational pattern will also change over time.

There are two major types of substitution possible: (i) the substitution of capital for certain types of labour; and (ii) the substitution of one type of labour for another. The inducement for employers to make substitutions is profit in market economies. Machinery may be substituted for workers because the machinery has become cheap enough profitably to replace the workers or because the wages of the workers have risen enough to make their replacement profitable. The allocation of tasks between labour and capital on one hand, and between different occupations on the other depends largely on the relative costs of capital and the various occupations.

An example of the capital for labour substitution possibility is the replacement of clerical workers by digital computers in computational and data processing tasks. An example of occupational substitution is the substitution of nurses and technicians for many tasks traditionally performed by physicians.

Substitution cannot occur instantaneously. First there must be a recognition by the manager of the need for substitution. Sometimes this occurs because the wages of one occupation increase rapidly and it becomes too costly to continue hiring these workers in customary numbers. Sometimes need is recognised because workers in an occupation quit to take better jobs elsewhere and workers of the same quality cannot be hired as replacements at the same prices. Once the need for substitution is recognised it may take a long time to discover just what kind of factors are needed. In the case of machinery, its design and manufacture may take a long time, while in the case of workers their training may be lengthy.

As a result of these substitution possibilities it is, in general, impossible to specify optimum occupational patterns for the future unless the expected composition of demand and the expected composition of the capital stock are also specified. It is possible in a planned economy to have a detailed bill of goods, but even here the uncertainties of the pace of technical change make detailed specification of the future stock of capital goods impossible. Detailed educational planning also faces problems in that much of the demand for education is a consumption demand and many of those who get detailed, occupationally oriented education will never enter the occupation.

These uncertainties suggest that detailed occupational planning can never be precisely correct. Nevertheless, the projection of future demand and supply may be valuable in forecasting potential occupational shortages. Occupational shortages may appear in various forms, such as: (1) rising economic returns; (2) job vacancies and quality reductions; and (3) departure of actual from ideal numbers.

Economic returns

In labour markets that are reasonably free to respond to supply and demand, a rising economic return to workers in an occupation is evidence of a shortage in the occupation. Such a rising return suggests that demand has increased faster than supply at the current wage. Demand for a particular skill is determined by its marginal productivity. Workers should be paid at most their marginal product, for why should an employer pay more? He may pay less.

In organisations with limited or fixed wage funds (such as government agencies) marginal productivity may exceed the wage, but in any organisation if the wage exceeds marginal productivity the firm is not acting in a profit-maximising manner.

Monetary earnings are not the only inducements to enter occupations. We must therefore either compare "net advantages" of money and other things, or look at relative movements if we are to identify shortage occupations. On occasion we shall ignore non-monetary considerations as if earnings data represent net advantages, but this is only an approximation.

Occupations with a large excess of present value of discounted expected lifetime earnings over occupations with similar qualifications and requirements are undermanned. If entry were free to these occupations and to the training requisite to the occupations, the rate of return would fall as supply increased.

If earnings measure marginal productivity in two activities, then reallocation investment from the lower to higher return activity will increase total output. This is true even if the two activities are occupations.

No single earnings index will do for all purposes. The average salary is sensitive to changes in age composition, even if age-specific earnings remain constant. Starting salary is not necessarily related to career earnings. One measure of career income is the "present value of expected lifetime earnings" used by Becker and by Houthakker. This is probably the most satisfactory measure, but it is subject to objections since the earnings of experienced and immobile workers may not increase very rapidly even if demand for the occupation does increase rapidly. This problem of lag in response may lead to relatively small increases in relative present values, even when there is a substantial shortage. Vaizey objects that the rate-of-return (a closely related concept) is irrelevant for supply behaviour.

Neither of these objections is effective in limiting the validity of present values as a summary of career earnings. The concept is relatively unobjectionable used as Becker and others have used it for different levels of education, but our use for occupational earnings is open to valid objection. The data is inadequate since it predicts expected earnings from the current cross-section. Perhaps more important is the fact that many of the occupations used in the present calculations are not career occupations, but represent occupations entered at different stages. Management, for instance, is not a common occupation of the very young but, in our calculations, lifetime incomes are calculated as if a person chose management as a career and followed it through, earning at each age the average earnings of persons in the occupation. In contrast, engineering is a good entry occupation to management. The most economically successful engineering graduates will usually be those that become managers. Hence, the present value of management may be biased upward because the earnings of young managers (who are exceptional) are included as a normal part of the career, while the present value of engineering may be too low because the earnings of only the relatively unsuccessful older engineers are included.

The secular movement of earnings in the educated professions will provide some measure of the responsiveness of educational systems. If there has been a strong secular tendency for demand to increase more for educated than for uneducated occupations and if the supply of both types increased by the same amount, then the relative earnings of educated occupations should have increased.

In judging the economic value of education, we seek the social rather than the private rate of return on investment. In estimating the costs we must use social costs, not private outlay, and in estimating the return we must use earnings gross of taxes, and perhaps some measure of any excess value of an occupation over its salary. That is to say, if teachers are underpaid, then the xcess of social over private benefit should be included in the social return.

Other economic evidence

It is obvious, however, that in the government sector internal rates of return cannot be our only guide to occupational shortages. Aggregate output (properly measured) might very well increase even if more resources were put into the training of persons with low earnings (such as teachers). We must look for evidence that these restricted labour markets are experiencing shortages. This is sometimes available in vacancy and qualification data.

Rising relative economic returns to an occupation may indicate an occupational shortage, but clearly there can be shortages in the absence of such rises. If labour markets are not responsive, perhaps because governments are either not willing or not able to bid for employees in the labour market, shortages may be indicated by changes in vacancy rates or by changes in employer-imposed requirements. Thus a shortage might occur in an occupation in which relative earnings were falling if vacancy rates were increasing or if qualifications were decreasing.

Vacancy rates are difficult to measure and interpret. There will always be some vacancies in any occupation, and the proportion is likely to be high in rapidly growing and highly specialised occupations. Hiring requires personal investigation and lengthy negotiations in high-level jobs; vacancy is not in itself evidence of a wage rate that is too low. Some firms have vacancies because they offer a salary which gives them a vanishingly small probability of filling the job. Such vacancies should not be counted. Occupations in which salaries have been rising rapidly may show large numbers of vacancies because of salary lags.

Measuring quality is seldom easy, and often not even possible. Even if there is agreement on measures of quality, the situation might arise in which the proportion of workers exceeding minimum qualifications increased, but the average level of qualification decreased. Has quality increased or decreased? It is hard to believe an occupation could experience a shortage while the level of minimum qualification, percentage of workers with at least minimum qualification, and average qualification increased unless entry was limited.

Planning targets and social goals

Occupational shortages are often estimated or projected by comparing "needs" or "requirements" to available supply. Usually these estimated shortages are only ideas, value judgments, or preferences and do not indicate an economic disequilibrium. They imply that something should be done about the present or impending shortage.

The projected shortages may appear in the form of countable vacancies, but if demand grows as much as projected and supply as little, salaries may be bid up, the number demanded may then decrease and the number entering the occupation may increase above the forecast. Demand for substitute skills may increase and methods of economising the short skills may be developed.

The naive implication commonly drawn from such projected shortages is that something (often a government programme) should be adopted to increase supply and that something should be done to reduce demand. It is not understood that the optimal occupational composition and the optimal wage-pattern are interdependent.

Skill substitution in the long period of adjustment may not take care of itself. Trade union pressure, licensing, and other controls may be important. Employers are often reluctant to change traditional skill patterns, and this makes adjustment more disruptive than necessary. Employers with rigid skill demands and hiring rates may be priced out of a rising market.

A projected shortage suggests that either a training decision or a substitution decision must be made. Substitution may be by substituting different skills or by using lower grades of the short skill. The quality

reduction solution is usually unacceptable in occupations such as medicine, teaching and science; the minimum acceptable level of the service is the customary level. Manpower planning is therefore most obvious and unobjectionable in such services. It is usually possible to establish a quality, or at least a training, standard that should be maintained for members of the occupation, and this often includes improving some of the current practitioners. It is also possible to establish levels of services that should be made available. Such a projected demand implies annual training requirements when coupled with attrition rates. It is easy to argue over objective standards such as years of training, average number of students per class, and the effect of raising the school leaving age, but there are few good substitutes for teachers. This is not so clear in medicine, science and engineering. The physician, scientist, or engineer can have his effectiveness increased by assistants with much less training and by students. Thus an acceptable level of education implies needs for teachers, but an acceptable level of medical, scientific, or engineering services does not imply needs for the corresponding occupations.

III. Responsiveness of systems

How needs are communicated to the educational system

There are three major ways in which the economic requirements of the training needs of the economy might be communicated to the higher educational system: 1) administrative decisions; 2) student choices; and 3) indirect influences, such as scholarship programmes.

If the government or educational decision-makers are concerned with manpower shortages, they may decide to expand or contract certain types of training by changing the number of places. Responses following administrative decisions are not always swift and sure. In democratic countries, administrative decisions follow long involved discussions in which interests are sorted out and mollified. The time from recognition of the need to the commencement of measures designed to meet the need may be a decade or more.

Decisions to re-allocate places and expenditure from one kind of training to another at the institutional level may take place more quickly, but it is usually difficult to justify these purely on the grounds of some supposed national need. Such changes are much more likely to occur in response to difficulties of obtaining good students in one subject and ease of getting good ones in the other.

Student choices may induce administrative decisions to expand one programme and to contract another. If student choice is free, such movements may occur quite rapidly. There may be institutional arrangements which effectively prohibit free student choice, such as extensive prerequisites that differentiate between students on the basis of past preparation. A general secondary education provides a much wider range for student choice in higher education, while a specialised preparation limits such choice and lengthens the period of time necessary for student choices to have effect.

Student choices are not necessarily related to national needs for trained manpower. Students (especially socially mobile ones) are often ignorant of what various careers offer, and they are influenced by parents and teachers. Students prefer high paid occupations, but the advantages of occupations with high vacancy rates, or the opportunity for promotion of a highly qualified person in an occupation in which qualifications are low and deteriorating are not obvious.

Indirect influences on higher education include programmes that induce institutions to increase the number of places (such as expansion grants limited to particular programmes) or induce students to choose training for needed jobs (scholarships or similar awards to students following prescribed courses). Such indirect measures are not coercive, and institutions and students not wishing to respond need not do so. Indirect measures may sometimes be adopted ad hoc without extended public debate. Such measures are often difficult to design and frequently fall short of their targets. Thus grants may lead an institution to improve quality or expand research without increasing output, and scholarships may simply subsidise students who would have chosen the subject in any event.

How systems respond

A system might respond to a change in training needs by expanding training in shortage occupations and contracting training in surplus occupations, or by doing one or neither of these things. In institutions in which teachers have some control and tenure, it may prove impossible either to reduce training in surplus subjects or to reduce teaching cost even if the number of students trained is reduced. Endowed institutions are reluctant to expand even if current outlays are guaranteed.

Speed of response will naturally be related to the degree of uncertainty that attaches to future needs for occupations. Changes of institutional emphasis are often disruptive, and if the permanence of a change in occupational needs is in doubt, very often the easiest thing to do is to wait. Future occupational needs in highly industrialised countries are quite uncertain. Highly structured higher educational systems cannot respond very quickly. To be highly responsive when faced with fluctuating needs, a system should be unified or general for a large percentage of the training time and specialised for only a short period of time at the end. It also seems desirable that the division of the training task between higher education and other institutions, such as the firm, should concentrate as much of the specialist training as possible within the institutions, agencies, or firms using the speciality.

Efficiency of response

In judging the efficiency of response of a system to needs, we shall consider its (1) selection efficiency, (2) training efficiency, and (3) speed of response.

Selection efficiency: An educational system can make two kinds of admission errors: (1) acceptance error, admitting the wrong applicant; and (2) rejection error, rejecting an applicant who would have been successful. The social cost of acceptance error is the net waste of resources

used in the unsuccessful educational or training attempt. This includes education expense and the foregone output that the student would have produced if he had been working, or attending another training programme, instead of attending the programme for which he was selected in error. Not all of the resources devoted to training are necessarily wasted if the student does not complete his training programme. The social cost of rejection error is the net increase in output that would be attributable to the educational programme.

The two kinds of cost are asymmetrical. The educational cost associated with acceptance error is cash outlay and is easily measurable; hence, it is easy to estimate the gross money cost of training people who do not finish a programme. The social cost of rejection error is entirely potential output.

It is this asymmetry that leads the Robbins Committee and many others to argue that the low attrition rate from British universities is a good thing, while the high attrition from American universities is a bad thing. This is not obvious.

Training efficiency: Training efficiency is measured by (1) costs, (2) duration of training, and (3) amount of unnecessary specialisation. Crude comparisons of costs that neglect quality and factor cost differentials may be misleading, but cost comparisons may be useful. Even if total costs are not comparable, certain cost factors, such as student-teacher ratios, may be relevant. There is a possible circularity, however, because one of the criteria of quality is the student-teacher ratio.

The duration of training is an important efficiency criterion because the sooner a given level of competence is achieved, the less the outlays on education and the smaller the foregone earnings of students will be. Too swift a pace may reduce the proportion of the age group that can qualify for higher education enough to raise problems of selection efficiency. There is evidence that early completion of studies increases not only lifetime productivity but the rate of productivity.

The amount of necessary specialisation depends on the occupations that graduates enter. A student who studies electrical engineering but works as a mechanical engineer may have wasted a large part of his time studying the wrong industrial specialty. It is inevitable that much of the technology of an industry is not used by some students. The cultural value of such specialised knowledge is not obvious. If a large proportion of students trained in one specialty enter unrelated occupations, there is a possibility that most of the specialisation is wasteful. It is therefore important to know the amount of unused specialisation. Specialisation known to be vocationally useless may still have educational value, but there is no general presumption that this is true.

Speed of response: A system that responds quickly to signals of changing needs is efficient only if the signals are correct and if the needs do not change too quickly. Examples are cited below where first impending surpluses, and then impending shortages were forecast. Quick response in these instances would have been inefficient. Too slow a response to increases in needs can lead to shortages, and too slow a response to decreasing needs can lead to surpluses.

IV. Higher education in the United Kingdom and the United States

American and British universities, the dominant higher educational institutions in both countries, are very different. British universities are selective, specialist, primarily undergraduate institutions, with relatively well paid teachers and government-supported students. American universities are less selective, generalist undergraduate and specialist graduate institutions with relatively poorly paid teachers, and self-financed students. British universities cap an academic pyramid designed to educate the most able 9 or 10 per cent of the age group for higher education, while American colleges and universities vary widely in student ability and are supplied by secondary schools preparing the most able third or half of the age group for higher education. British professional education admits students directly from the secondary schools, while most American professional schools require an earlier degree. In the United States, most professional education and much business and technical education takes place within the university or college framework, while British universities usually limit themselves to traditional university studies.

British universities are much more uniform in quality and organisation than are American universities and colleges. The major types are: Oxbridge, Scottish, federated, redbrick, new, and ex-CATS.

Oxford and Cambridge are able to pick their teachers and students, although the methods of selection do not guarantee success. They are more prestigious than most other universities and their graduates enjoy better success in the Civil Service, Diplomatic Service, and in politics. Some of this success is the result of manners and models rather than better quality of education.

The Scotti universities take younger students than the English universities and give broader education. The ordinary degree is very broad, and the honours degree is usually a joint degree of two subjects.

The civic, or "redbrick" universities (e.g., Manchester and Birmingham) emphasise science and technology and are not collegiate or highly residential.

London and Wales are federated arts colleges, medical schools and specialised schools such as Imperial College and the London School of Economics and Political Science. The "new" universities (e.g., York, Sussex and Warwick) that have started in the past few years, vary widely. Some are collegiate and at least one aspires to be fashionable. Experiments are common. Some have tried to abolish departments. The new universities are mostly near small cities and are staffed by relatively young teachers.

The "ex-CATs" or Colleges of Advanced Technology that have been designated as universities, will stress science and applied science.

The colleges of education are three-year institutions that prepare most of Britain's teachers. They are grouped into regional institutes (all except one centred on universities) for purposes of planning and co-ordination.

There are three major types of American universities: private (e.g. Harvard, Stanford and Duke); state (e.g. California, Michigan and Illinois); and urban (e.g. City University of New York, New York University, and Boston University). The private universities usually emphasise graduate study, have small, expensive (tuition $1,400 to $1,800

per year) undergraduate liberal arts colleges and recruit students from over the nation. The state universities are supported by state grants, charge low tuition ($0 to $200 per year) to students from the same state, and offer study in subjects as diverse as law, medicine, dentistry, veterinary medical technology, nursing, optometry, social work, criminology, police administration, education, architecture, engineering, city planning, pharmacy, forestry, agriculture, business, insurance, accounting, real estate, as well as arts and sciences. Some state universities are centres of agricultural and industrial extension and adult education. The urban universities may be private or public, but their range of subjects is usually much less broad than the state university, and they often emphasise business studies.

Higher educational institutions other than universities include: institutes of technology (e.g. California, Massachusetts and Georgia), liberal arts colleges (e.g. Swarthmore, Oberlin and Reed), teachers' colleges, junior colleges, and technical institutes. All these institutions except junior colleges and technical institutes grant degrees.

In the United States there has been an irresistible tendency for every lengthy course of formal study for occupations to be brought into degree granting institutions. The English universities have an age-old tradition of resisting change, having opposed the introduction of Greek, science, technology and business in turn. To-day, American universities are collections of diverse schools and departments responding to a wide range of needs while British universities are highly specialised institutions for training scholars, teachers, scientists, and engineers. Although the pattern is changing with the introduction of more joint honours degrees and non-specialised first years, the English university student is usually a specialist student studying in a specialist department. Even the arts students are taught to be specialists. The specialisation aggravates the conflict between the "two cultures". The lack of general education in English universities makes them much more vocational in their restricted range of vocations than American universities, which stress general education and limit concentration in their wider and less traditional set of vocational objectives.

V. Response in the United States

There is no manpower plan setting out national needs for qualified manpower in the United States. It is generally believed that there is need for as many graduates of higher education as are likely to appear. The economic return on higher education is as great as the return on industrial capital, probably somewhat greater. Vacancy rates for occupations requiring post-secondary education such as physicians, nurses, engineers, teachers, and technicians are much higher than rates for industrial jobs. The quality or qualifications of persons in high level occupations have been increasing, rather than decreasing, and this is the only evidence that contradicts the description of the market for qualified workers as one of economic shortage.

Formal, but unofficial, targets have been established for few occupations, among which are scientists, engineers, physicians and teachers.

The major way in which needs are communicated to higher education is through student choices. Except for medicine, for which there is a large excess demand for places, almost every high-school or college graduate can find a place in an institution of higher education, and most of these can find a place in the major of his choice. Some institutions limit the number of students admitted to particular programmes, but most non-engineering first-year students are admitted to the college without much attention being paid to their intended major subjects.

There is much advising, setting of targets, and fussing by committees of interested citizens and government agencies, but there appears to be no recorded instance of any institution responding to advice not accompanied by financial assistance.

Conditional grants of money for facilities and student aid are seldom refused by single institutions and never by the higher educational system as a whole. Large grants have encouraged an advanced placement scheme, facility and loan programmes for sciences and engineering, and medical education.

The numbers of students in higher education and of degrees granted have increased both absolutely and as percentages of the relevant age groups. There have been several large changes in the proportions and numbers of students in particular fields and these changes have reflected student choices almost exclusively, except in medicine. There has been no observable tendency for one specialty to expand because another has been intentionally held back; rather there has been a general expansion in all subjects.

In the past, American higher education made large acceptance errors (for which the social cost is generally small) and significant rejection errors (with large social costs). Many of the most able high-school graduates did not enter higher education in the past, especially if they came from low-income families. There is still an inefficient distribution of educational expenditures, with too many rich but stupid children receiving better education than they need, and too many poor but able students receiving inferior education. Available scholarship funds are too small to permit more than a fraction of the most able poor to attend the best private colleges and universities. Programmes such as the National Merit Scholarships and National Defence Education Act (NDEA) fellowships and loan funds have been effective in improving the opportunities of the most able few per cent.

The large acceptance errors may appear to be costly in terms of admitting many students who do not complete education, but any increment of higher education appears to be valuable, and most students think that it is better to have gone and loafed than never to have gone at all. The large groups of students who are exposed to higher education in the United States permit selection to be made more by performance than by measured aptitude.

Students in higher education display a wide range of ability, and the level of competence represented by a given degree also varies widely. Acceleration in school is thought to expose immature children to unfavourable non-academic competition from older children; ability grouping is practised widely in schools, but leads to "enrichment" rather than acceleration; advanced placement in college is usually used to enrich the college programme rather than to accelerate graduation. As a result, many of the most able undergraduates receive rich and stim[illegible]

education in their bachelor's degree programmes, while many of the least able learn very little. The practice of requiring a four-year degree as a prerequisite to professional education is wasteful and time-consuming for many students.

Few complain that American college students, other than engineers, are overspecialised. More (especially graduate-school teachers) complain that students lack an adequate understanding of their specialty. The competition of different departments for undergraduate students often leads to a policy of complete laissez-faire for students, and many students, even able ones, choose an easy programme in order to maximise the important grade-point average, a good strategy since no one outside of a department can distinguish an easy course from a hard one.

The American higher education system usually responds to needs rapidly, if it responds at all. Universities have not expanded their medical schools, despite obvious needs, but several needed engineering and science specialities have expanded rapidly. Re-allocation among specialties with similar average costs is often quite rapid.

Scientists

There are two principal schools of thought concerning the need for scientists. The first is composed principally of scientists and does little more than assert that more scientific research is desirable and therefore more scientists are needed. The second school relies primarily on the projection of present and past ratios of scientists to total employment by industry to forecast or hypothesise future needs.

It is far from obvious that the United States should spend more on science. There is no strong relationship between amount of spending on science and economic growth rates, nor is there an obvious relationship between amount of scientific spending and national power. Discussions of amounts are meaningless unless detailed allocation is specified, and no one has yet developed a rational way of allocating scientific spending.

A shortage of science Ph.D.s is expected. The President's Science Advisory Committee called for a rapid expansion of the number of Ph.D. degrees to a rate of 7,500 a year in 1970 in engineering, mathematics, physical sciences; an increase from 2,927 awarded in 1960. This requirement is larger than earlier projections. It would require increases in the proportions of bachelors proceeding to doctoral work. The financial aid and graduate department expansion required now seems possible in the light of recent legislation.

The needs and expected needs for scientists have not been reflected in the labour market. Mathematicians, chemists and physicists typically start with lower salaries than engineers, although they probably make somewhat more than non-scientific graduates. Promotion opportunities for science graduates are probably somewhat less than for engineering graduates, and the rate of progression of scientists, salaries is therefore somewhat lower than for engineers. The present values of lifetime earnings of scientists are much below the lifetime earnings of engineers for college graduates. The salaries of Ph.D. scientists are not particularly attractive, relative either to the salaries of scientific bachelor's degrees or to the earnings of persons with professional degrees.

There has been a rapid growth of fellowhip and loan aid in NDEA, NSF, NASA, and other government programmes to encourage research.

Universities have responded rapidly and the number of fellowships awarded has increased to the limit of available funds. Facilities grants from NSF and NASA have been eagerly competed for by universities seeking to expand their research. With space provided through one government grant, it is possible to obtain research grants which permit the hiring of professors and graduate research assistants. Even inadequate rates of government compensation for overhead expenses (about which university administrators complain endlessly) are acceptable when the government provides the overhead. Science, along with engineering and medical specialties, received special treatment. Better financial aid is available to graduate students entering these specialties than in the arts and humanities.

Efficiency of response in science has been very satisfactory. The number of scientists produced by the system has increased swiftly, although some specialties have expanded less rapidly than demand. Since World War II the proportion of all male graduates in physical science has remained fairly constant at about 5 per cent. In the past few years the proportion with mathematics degrees has increased sharply from 1.5 per cent in 1954-55 to 4.7 per cent in 1963-64. Astronomy grew and geology decreased during the decade, reflecting changes in demand. The ratio of Ph.D. degrees to bachelor's degrees in the sciences has grown steadily. The increase in number of doctorates has been too slow to satisfy the rapidly expanding needs of all levels of higher education. In both these situations excessively low salaries have made teaching non-competitive with industrial, institutional and government research. This has led to the complaint that the too rapid expansion of industrial research now is impeding the training of scientists for research in the future.

Selection in higher education for science has never been satisfactory. Few students, even the most able, in small and rural high-schools get adequate mathematics and science preparation, and few of them choose science majors if they go to college. Even among students who enter college intending to major in science, large proportions change their minds. Despite transfers and relatively unattractive economic conditions, science appears to be attracting a very high proportion of the most able students. Large percentages of the most able students take enough high-school mathematics and science to prepare themselves for college courses of study. About 30 per cent of the National Merit Scholarship semi-finalists (approximately the 2 per cent of high-school seniors with highest aptitude test scores) choose scientific majors or scientific careers in each year. The average I.Q.s of science majors are high relative to other majors. The per cent of persons in the highest I.Q. groups receiving Ph.D.s is higher in the physical sciences than in social sciences, humanities, biological sciences or education.

Science gets many able people. Does it get too many? Ability is seldom highly specific, and the method of selection used for National Merit Scholarship semi-finalists is unlikely to pick people with specialised talents only. It is not difficult to think of many occupations that require persons of very high ability and that are likely to be deprived of people of high ability by the enormous intellectual attractions of science.

Engineers

Goals for engineers have usually been coupled with goals for scientists, but engineers are much more "factors of production" than

scientists. Their work is related more to applied research and development and to production than is that of scientists. The growth of research and development activities, or at least what is labelled R and D activities, has resulted in a reduction of the ratio of production engineers to all workers in many industries. Much of this reduction has come from the transfer of graduates from drafting and bench work as their cost has increased, and probably did not decrease production very much. Most employers dislike any kind of change, and it is natural that this situation was labelled a "shortage of engineers".

The shortage of engineers first received attention during the Korean War, when vacancy rates rose rapidly. Starting salary rates did not rise any more rapidly than starting salaries for non-engineers until about 1955. In view of the secular decline of the ratio of engineers' average earnings to the average earnings of other professions and of all workers, Blank and Stigler concluded that "... up to at least 1955 there had been no shortage - in fact an increasingly ample supply of engineers". They grant that "... after 1950 there was a short and relatively minor reversal in (the decline) of relative earnings of engineers". This reversal they term "... hardly more than a minor cross-current in a tide". Tides have been known to turn, however, and both Hansen and Arrow and Capron pointed out that in the period since the Korean War the salary evidence indicated a relative shortage.

In evaluating the performance of higher education, however, we cannot dismiss the long-term change in earnings as readily as did those who accept the existence of a shortage. Engineers' average earnings are below the average earnings of professional workers such as physicians, dentists, and lawyers. Engineers as a rule do not do graduate work, but even engineers with Ph.D.s who have done as much postgraduate work as lawyers and dentists, and almost as much as physicians, make far less than workers in these occupations. The current level of engineers' salaries is lower relative to these other professional occupations than it was before World War II.

Student response confirms that salary levels are relatively low. During the period when talk of the engineering shortage was loudest, the proportion of first-year male students entering engineering declined from 18 per cent in 1957-58 to 10 per cent in 1964-65. This trend was also observable among the most able students: 30 per cent of National Merit Scholarship finalists chose engineering in 1958, but only 20 per cent in 1963. Thus at a period when every student was alerted to the opportunities for engineering as a profession, a declining proportion of them chose to enter the profession. Moreover, this change occured during a period when the proportion of students graduating from high school who were qualified to pursue engineering was increasing. Student response shows that, despite rising relative starting salaries, engineering is less attractive than in the past.

The decline in the proportions of new entrants to engineering may not be merely perverse. There was a substantial increase in the number of mathematics majors and the proportion of all male graduates in mathematics during this period. Job opportunities in mathematics increased rapidly during this period.

It is also likely that much of the apparent increase in engineering starting salaries merely reflects a change in the industry mix of starting engineering jobs. Many of the new engineering jobs since the mid-1950s

have been in the missiles-aerospace industry, an industry always noted for high starting salaries, short duration of employment and a high degree of employment instability. The high starting salaries in this industry (that are so important in the overall average starting salaries for all engineers during recent years) make up for less-than-average non-monetary advantages. Engineering starting salaries have increased more than engineering "net advantage".

Past declines have led to the expectation of future shortages. The projections that have been made have been optimistic about the future supply of engineers in the light of freshman first year enrolments in the past few years.

The response of higher education to the need for engineers has been satisfactory in that institutions have been willing to increase enrolment and have joined in attempts to attract more students. The problem is that there have not been enough students. Many college students transfer from engineering, and few of them go into science. Engineering schools select the wrong students, but no one knows what to do about it. Changes in the proportions in the various specialties have responded to relative demands. There have been increases in the proportions of electrical and aeronautical engineers and decreases in the proportions of civil and chemical engineers. The changes have not been rapid enough, for large proportions of those trained in relatively surplus specialties work in other specialties. This is evidence of overspecialisation and incorrect specialisation. Many engineering educators recognise this problem and have moved toward a much more general curriculum of "engineering science" that de-emphasises industrial specialisation.

Physicians

The most comprehensive measure of medical need was the work of Lee and Jones who derived the number of physicians needed to treat and prevent diseases at a good level of practice. They concluded that about 135 physicians per 100,000 population were needed, and this implied a small deficit at the time of their study. The deficit was actually much higher, because they did not exclude retired and non-practising physicians.

The most recent government projections of need accepted the current ratio of 135 physicians per 100,000 population as the desirable level, and deduced from expected population growth and attrition the number of physicians needed. This implies that existing shortage is to be maintained, and in fact worsened. The projected pattern of population growth will lead to increased numbers and proportion of older persons who use a much higher than average amount of medical services. The greater than average use of older persons will be increased even more as a result of the greatly expanded medical and hospitalisation programmes available under the newly adopted Medicare programme.

Things may not get worse, however, for better medical care and smaller than current physician-to-population ratios can be made consistent. As a result of the worsening shortage since World War II many improvements in efficiency have been made. The virtual elimination of the house call reduced travel time for physicians. Bed-ridden patients are hospitalised so that the physician can see them all in an hour or two. Hospitals have been substituted for physicians. The patient pays the

hospital, and the physician sees more patients, which increases his productivity. In the past many patients made appointments with their physicians; to-day they wait in the physician's office, even if they have appointments. The subordination of the patient to the convenience of the physician economises the physician's time and increases his productivity since there are fewer awkward gaps between patients when no fees are being earned. There is a question of social cost here. It is possible that total output would be increased if resources were directed to the training of physicians and waiting times and hospitalisation were reduced.

Physicians' earnings are higher and have increased faster during the post-war period than earnings in any other career occupation. This reflects the slow growth of the occupation, high income elasticity and low price elasticity of demand for physicians' services, and the rapid growth of medical and surgical insurance during the period. The rising earnings indicate a shortage in a market in which price is free to rise. There is corroborative evidence of a shortage in the increase in the importation of foreign-trained and often low quality physicians for hospital posts, the growth of chiropractry, medical quacks and other cheap substitutes, and numerous medical vacancies, especially for physicians in government.

The capacity of medical schools is the effective limiting factor in the growth of the medical profession. Despite the great expense of medical training, there is no lack of qualified applicants, although in recent years the excess demand has been noticeably smaller than during the years when large numbers of veterans were graduating.

For years it has been clear to public health authorities and medical educators that the output of physicians was not increasing fast enough to satisfy needs, but funds have not been available for expansion. Medical education is extremely expensive. Professors expect to be paid as well as physicians and a teaching hospital is a bottomless pit into which universities unfortunate enough to have medical schools must pour ever-increasing amounts of money. Tuition is high (about $2,000 a year) and most schools believe they can increase it no more. Many medical students graduate with large debts, and have several years of privation as interns and residents ahead of them. Despite the obvious needs, the American Medical Association has persisted in its depression-born attempt to slow down the growth of the profession and has opposed Federal proposals to aid medical education. The tardiness of American government in supporting medical education is now to be compensated for by its munificence.

Recent legislation provides loans and scholarships for students in medicine, osteopathy, dentistry, and optometry. New medical training facilities are to be built: 14 new medical schools by 1969, making a total of 101. The number of physicians may reach 360,000 by 1975 from 290,000 in 1963.

The efficiency of medical education in the past has not been outstanding, but no institution and few states were able to expand because of the high cost. Medical schools in some states admitted poorly qualified local students rather than much better qualified out-of-state students. This practice largely accounts for the admission of the 17 per cent of all students who had "C" averages. If Federal aid had not been extended to medical education, the gap between needs and supply would have continued to grow.

Teachers

The ratio of students to teachers in primary and secondary education has been remarkably stable in the United States, falling from 27.4 in 1949-50 to 27.1 in 1959-60. Thus in terms of numbers there has been no obvious worsening of the shortage of teachers. There are some measures that suggest qualitative improvement in the past few years. The ratio of male secondary school teachers to all secondary school teacher rose from 43.3 in 1949-50 to 51.8 in 1959-60. Many states have increased the standards of certification so that four years of college are required for a permanent teaching certificate almost everywhere and some states require a fifth year for secondary school teachers. About two-fifths of the secondary school teachers have the master's degree. There are shortages in such specialties as mathematics, physical science and English composition. The principal reason for the shortage has been the low salaries of teachers relative to industrial salaries. R. and D. computers, and technical writing have created large new markets for persons trained to become teachers and, as a result, many schools, especially the smaller ones, have been unable to staff their science and mathematics classes with trained teachers.

The salary criterion for evaluating the teacher shortage is applicable, even though most teachers are public employees. There is much competition between school districts. Many states establish a minimum scale, and school districts that can afford it pay over the scale. In 1962-63 average salaries ranged from $7,550 in California to $3,790 in Mississipi for secondary school teachers, and from $6,750 to $3,480 in these states for primary-school teachers. Aside from salaries, there are other attractions and repulsions to particular communities and systems. Public school salaries have stayed slightly higher than the average earnings per full-time wage and salary employee, except for a short period during and immediately after World War II. Since then the ratio of teachers' salaries to salaries for physicians and engineers has increased. Thus there is salary evidence to suggest a teacher shortage. Most school systems have pay schedules consisting of a basic rate and increments for longevity and advanced qualifications, and compete by shifting pay schedule. Teachers have successfully resisted payment by "merit" or payment on individual market prices. As a result, there are shortages in specialties in good demand outside of teaching, with vacancies and unqualified teachers holding classes.

The communication of shortages of teachers to higher education is usually quite direct. Teachers' colleges and schools of education in universities usually handle student job placement. Teaching is a major occupation for college graduates. About one tenth of men's first degrees and almost one half of women's first degrees are in education. One third of men's master's degrees and two-fifths of women's master's degrees are in education. Information of shortages in particular specialties is used in counselling students, and special efforts are made to meet the most pressing shortages. An outstanding example of this is the NDEA and NSF programmes for science and other subjects. Summer and school-year institutes for teachers of foreign languages, English, reading, history, geography and civics are conducted under NDEA supported programmes, and institutes for teachers of science and mathematics are conducted with NSF support. The NSF programmes have been attended

by more than one half of the science and mathematics teachers in the nation's secondary schools.

The NDEA loan programme also provides a specialised kind of government influence, since students entering teaching are allowed to cancel 10 per cent of the loan for each year in teaching (with a maximum of five years). These loans are made mostly to good students who intend to teach or to those with superior ability in mathematics, science, or modern foreign languages.

Teaching has always attracted many women graduates, even the most able. About one fourth of the female 1957 National Merit Scholarship semi-finalists planned to teach as of 1961. Few of the men entering teaching are among the most able. Only 3 per cent of the male 1957 National Merit Scholarship semi-finalists planned to teach in primary or secondary school in 1961. Teaching is quite an attractive occupation for women. The pay is good. Job requirements are fairly standard, so that a woman may change jobs without a serious career set-back if her husband is transferred (longevity is usually figured as teaching experience wherever attained). It is usually easy to re-enter the occupation after an absence. The level of pay for men is too low to attract many men of ambition and ability. For those able men who enter the occupation, however, there are many opportunities for promotion, but these lead out of teaching and into administration. Teaching is an obvious model role for the upwardly mobile boy or girl, so that it draws boys primarily from lower income classes, but girls from all classes.

In view of the foregoing considerations, it is difficult to say much about selection efficiency. Education students appear to be highly motivated and quite "loyal" to their intended major and occupation during schooling. This suggests that they are the right students for the career. It is hard to be satisfied with the levels of intellectual ability of the male students entering the occupation, but it is hard to imagine many college professors advising able students to teach school especially since college teaching offers more money and more intellectual challenge, as well as great unmet needs.

Training efficiency is a problem. Since the late 1950s there has been a continuing criticism of teacher training curricula and philosophy. Much of this has been extremely negative and reactionary. "Progressive education" has been pilloried, usually from ignorance by intelligent men who simply want academic subjects stressed. Over-emphasis on courses of teaching methods at the expense of subject matter was singled out for criticism. In some states, such as California, revolutionary changes were made. Each new secondary school teacher in California must now have an academic major (about 24 credit hours in a single subject), a set of subjects in his certificate field (about 20 credit hours in natural science, or social studies, or other fields), 9 hours of education courses, a fifth year of college, and practice teaching for certification.

Many college professors outside education favour such changes, sinc [illegible] reinforce the student's knowledge of a subject-matter field at the [illegible]ense of educational methods courses. The reduction of the specialisation in education courses will have other effects. Able students with academic majors will find it easier to enter graduate school or industrial labour markets.

Other occupations

In 1961–62 only two fifths of new college graduates were trained in the specialties of medicine, science, engineering or education. This shows how much of the effort of American higher education is directed toward the general needs of business and government. Many American college graduates probably work in jobs that do not require a college education. This does not mean that a college education does not help. If we use a rate of return criterion, it seems that educational investment pays the highest returns in occupations where it is not necessary. At 6 per cent, the present value of the income differential associated with four years of college education was $49,000 for real estate agents and brokers, and $33,000 for insurance agents and brokers, but only $23,000 for engineers and chemists.

Eckaus estimated the educational requirements of the labour force in 1940 and 1950, and found the following:

Requirements	Years of education		
	1940	1950	1964
General education.	9.7	10.1	–
Specific vocational	1.3	1.4	–
Median years of school of labour force 18 and over	–	10.6	12.2
	Per cent of labour force		
Jobs requiring 4 or more years of college .	7.1	7.4	–
Workers with 4 or more years of college. .	5.9	7.4	11.2

According to these figures, there was a gross shortage of education in 1940, and many workers were under-educated for their jobs. Gross balance obtained in 1950 for jobs and workers with higher education. The proportion of jobs requiring college probably did not increase nearly as rapidly as the proportion of the labour force with college education in the period 1950–64. It was the fear of such a trend that led Harris and others to announce an impending glut of college graduates in the 1950s, but the period 1949–59 saw a widening of earnings differentials between college graduates and high-school graduates rather than the predicted narrowing. Thus far the surplus of college graduates has not appeared.

The large numbers of university graduates who enter business as trainees, accountants and salesmen show the close interdependence between higher education and business in the United States. While large numbers of graduates in most specialties enter business, degrees such as engineering, and business and commerce have the largest proportions. About one fifth of all men's first degrees and almost one tenth of master's

or second professional degrees are in business and commerce. The average earnings of graduates in business are high relative both to the earnings of non-graduates and to the earnings of graduates not in business. There seems little reason to doubt that business pays premiums for graduates and goes to great lengths to recruit even non-technical graduates. It is sometimes alleged that much of the hiring of graduates for business is conspicuous consumption, but this can explain only a tiny fraction of the market for graduates. It is possible that business uses college graduation as a measure of motivation and perseverance. On the assumption that most high school graduates with high intelligence and good motivation will graduate, many businesses restrict recruitment for jobs that lead to management to graduates. The assumption is approximately correct, since entry to college is usually open to most students of even modest intelligence on a part-time or night-school basis, or even full-time, if only their desire is strong enough. One result of this kind of selection process is the progressive limitation of opportunities for business leadership to persons with higher education, whether or not it is the relevant selection criterion.

VI. Response in the United Kingdom

There is no manpower plan that establishes detailed occupational needs in the United Kingdom, although special occupations such as physicians, teachers, and engineers have had targets proposed for them. The social rate of return on investment in higher education is somewhat lower than the rate of return on investment in secondary education, suggesting that funds should be directed toward expanding education from ages 15 to 18 rather than to expanding higher education. Nevertheless, the private rate of return on higher education is quite high, and it is to be expected that an excess demand for places in higher education by qualified school leavers will continue. There is a general belief that shortages exist in certain occupations in terms of salary changes, vacancies, and national goals, but not in terms of qualifications. There has been improvement in the qualifications of most high level occupations.

The major way in which national needs are communicated to the higher educational system is through negotiations between the Treasury on the one hand and the Department of Education and Science and the University Grants Committee on the other. The Treasury decides the amounts to go to the universities and other higher educational institutions, and the UGC decides how the universities' grant is to be portioned among the universities. The UGC accepts a responsibility for responding to national needs, but retains a considerable degree of freedom in interpreting what the needs are. British observers view the delegation of allocational authority from government to the UGC as a marvellous social intention, but the advantages of a university being dictated to by its competitors rather than the government are not always obvious. Universities rely on the government grant, and they lack capacity to finance their own expansion. The national grant is never sufficient because the British government is always short of money. This is because it has nationalised, socialised, or assumed responsibility for the activities of education,

medecine, housing, and power that have high income elasticity of demand in almost all countries. Since all these activities are heavily subsidised, often with zero costs charged to the consumer, consumers want more than they can have. The chronic excess demand for services priced under the price that would be paid in the market is most striking in higher education. Because of the excess demand for places in higher education, students have to take what they are given, rather than what they want. As the proportion of qualified school leavers attending university contracted during the 1950s, the proportion of students attending teacher training colleges and further education increased. This does not reflect a decreasing taste for university education but limited capacity. In such a system, the central authorities should be able to obtain just about the distribution of higher qualifications they wish by regulating the number of places available. The fact that this has not been done in the United Kingdom probably reflects past misunderstanding of the demand for higher education, rather than scruples about interfering with student choices.

There have been substantial changes in the distribution of qualifications between different specialties in the British higher educational system. The proportions of pure science and applied science among all degrees have increased, and the proportion of medical degrees has decreased. The proportion of teachers in all higher educational qualifications has increased. Within the faculties there has been much less response in the various specialties. The changes have reflected the spending decisions of government and the UGC.

The British higher educational system, and especially the universities, makes few admission errors and many rejection errors. Most of the rejection errors are made in secondary school, rather than by the universities, but the result is the same. Too few able students receive higher education, especially working-class children.

Cost variations among institutions of the same kind are relatively small, although students at Oxford and Cambridge receive more expensive educations than those in other universities, and students in the rich Oxbridge colleges receive more expensive educations than those in the poor Oxbridge colleges.

The duration of training in British higher education is shorter than in any country with comparable standards, but the excess demand for places leads many students to try for admission in more than one year, and this creates delays. The pace of education is probably too fast for many secondary school students, and this may be related to the excessively low proportions of able students who achieve five "O" level passes. Many colleges of education students believe their training is too long.

Complaints of over-specialisation are frequently directed against British higher education and secondary education after "O" level. No country has so specialised a system. At age 16 most students choose either arts or sciences for the three or more subjects they study for "A" level, and very few mix arts and sciences. Few universities (except in Scotland) have a general course that permits students to choose either an arts or a science major after a first year. Students are usually admitted to a faculty or even a department as first-year students and transfers are usually quite difficult. The Robbins Report criticised over-specialisation and made its recommendation for expansion of university education conditional on the increase in the number of more general or joint honours degrees.

Official response to needs has been slow. The government did not respond to increased needs or increased student qualifications for an extended period in the 1950s. However, institutional response to changes in allocations has been very rapid, and student response similarly rapid because of the general excess demand for places.

Science

There is no obvious shortage of scientists in the United Kingdom, if shortage is measured by market criteria of salary rise, salary level or job vacancies. The ratio of scientists to total employment is lower than in several other countries, such as the United States, but this reflects the lower level of expenditures on research, rather than market shortage. The belief that the United Kingdom should employ more scientists to do various things suggests an "unmet need" (in Jewkes' phrase) rather than a "shortage". The market situation has been in fairly close balance since the 1950s and this balance is expected to continue in the immediate future.

Salary data are not available for making extensive comparisons of the earnings of scientists and others. In 1955-56, scientists appeared to earn less than the professions, while in the early 1960s qualified chemists earned about the same as graduate engineers. It seems likely that engineers' earnings have increased somewhat more over the past decade than scientists' salaries. A very large proportion of scientists are employed by schools, universities, and government, and this has probably slowed down the rate of increase of scientists' average earnings.

About one fourth of the university students in the United Kingdom study science, and one-fifth study technology. About one half of the "A" level passes in recent years are in science and mathematics. Thus the British higher educational system is strongly concentrated in science. Postgraduate education in science is of growing importance. Almost three-tenths of those taking science degrees go on to further work.

By its own standards, British higher education is quite efficient in the selection of science students. There are few dropouts and this is true also of graduates, for most of them find work in science-related fields. It is commonly believed that there are not enough able students for physical science places, but there is strong opposition to lowering admission standards. The grammar schools usually encourage able students to do pure science. Science gets a very large fraction of the most able British students.

Engineers

The shortage of engineers in the United Kingdom has persisted for a number of years: despite this the number of engineering graduates has not increased as fast as the number of scientific graduates. Engineering graduates earn about the same as chemistry and physics graduates. Qualified engineers in 1955-56 averaged less than any other profession studied except architects. Earnings at ages 30 to 34 were higher than accountants, barristers, solicitors (Scotland), architects and surveyors, but earnings did not increase as much with age for engineers as in most of the professions. Over the period 1955-64 engineers' earnings increased more rapidly than any other group studied and this indicates a shortage

by the economic return criterion, but the number of engineering graduates and non-degree qualifications have not increased as much as other specialties, such as science.

About 60 per cent of British engineers are not university graduates, so that earnings of qualified engineers might be expected to be lower than earnings of graduate occupations. Graduate engineers earn somewhat more on the average than non-graduate engineers.

The proportion of all new engineers qualified by university graduation has risen over the past decade, despite the decline in the proportion of qualified secondary students entering universities. Thus during a period when proportionately more persons might be expected to pursue non-university routes to qualification if there were really an intense market need for engineers, the reverse has occurred. The number of engineering graduates and new qualifications increased somewhat more slowly than the number of science graduates, although more rapidly than the number of all graduates. The system responded to the needs of the economy for trained manpower, but engineering education did not expand rapidly enough, either in universities or in further education.

The best engineering students usually follow the straight-forward university degree programme. Here there are few dropouts. Probably the next best group now study for the Diploma in Technology under a "sandwich" course, which alternates study with work. Other routes to qualification include the Higher National Diploma and the Higher National Certificate and the institutional associateships that are gained by examination. The largely part-time nature of much of the work and study toward qualification may be very inefficient. Completion rates are hardly low outside the honours degree level courses. Many of the s able students who follow the part-time path to qualification might l fit from full-time study or a sandwich course, but because they do : neet university standards must pursue part-time courses that probal wer the probabilities of completion even more. The importance of th :al and regional technical colleges and the established technical and chnological syllabi as an educational resource cannot be exaggerated.

The problem of over-specialisation and obsolescence (echnological education is serious everywhere, but the structure of I itish education for engineers makes adjustments somewhat slower than mig t be desirable. Since the examiners and teachers are separate, fairness usually requires that content revision proceed slowly. The brief duration of engineering studies requires that very little other than engineering proper be taught. It is usually assumed that the student will have had most of the science and mathematics he needs before he enters engineering training proper.

Physicians

The shortage of physicians in the United Kingdom is shown by vacancies and norms rather than by a rise in earnings. Physicians' earnings have fallen in dollars of constant purchasing power and relatively since the early post-war period. There is no excess capacity in medical schools, and the qualifications of medical students are quite high. Even so, there are areas in which it is difficult to find a physician willing to add patients to his panel, physicians with more patients than they want, frequent complaints of overwork, and waiting lists for admission to hospitals for delavable surgery. The UGC has termed the situation "a critical shortage of doctors". The shortage will get worse.

The inability of the available resources to provide as much medical care as the population wants at the zero price imposed by the current organisation suggests a shortage. Obviously if prices were higher the quantity demanded would be lower, but there is little question that a genuine shortage exists to-day.

The lack of capacity to train more physicians is the result of a deliberate policy decision. As in most higher education, there is excess demand for medical places, but there is a bottleneck in physical accomodation in preclinical years. The proportion of medicine in all first degrees fell from 12 per cent in 1953-54 to 7 per cent in 1963-64. The number of new physicians will increase very slowly for the next few years. This is because the Willink Committee in 1957 recommen[illegible] per cent reduction in medical student intake to avoid an impending surplus of physicians. The number of students dropped the next year. In July, 1961, the Ministry of Health reversed the recommendation.

Over the past half-century the system showed a remarkable capacity to expand medical training. Since World War II, training has increased amid great difficulties. The major constraint is simply one of inadequate funds for expansion. The educational system has not been responsive to needs during the post-war period because government has not placed a very high priority on the expansion of medical school facilities.

Teachers

The British teacher shortage is both quantitative and qualitative. More and better graduates are needed in secondary schools. More teachers are needed to meet legal maximum class sizes. The shortage is expected to continue in the future. Despite the rapid growth of secondary school enrolments and the relatively slow growth of university and training college enrolments, the quality of British teachers has improved when measured by conventional qualification standards. An increasing proportion of graduate teachers have received teacher training and the duration of training for non-graduate teachers has been increased from two to three years.

The teacher shortage is readily measured in terms of numbers necessary to meet specified standards. In 1963, an estimated 9,600 teachers were required to reduce maximum junior class size to 40, and 30,100 teachers were required to reduce the maximum senior class size to 30.

The shortage is concentrated in certain specialties, such as mathematics and science. Existing salary schedules are not high enough to attract good quality science graduates and there is little support for differentials for science graduates to make teaching competitive. Considering the very large proportion of sixth form students who specialise in science, the shortage is likely to contribute to the shortage of scientists and engineers by making scientific studies less attractive and harder to enter for future university students. The lack of attraction of science teaching for mathematics and science graduates may be inferred from the low classes of degrees of graduates entering teaching. About one fifth of the persons with scientific and engineering qualifications in 1961 were teaching. A survey of 1949-50 university graduates showed that only 7 per cent of first-class honours degrees in science entered teaching as compared to 17 per cent of first-class honours degrees in arts. A larger proportion

of science teachers (9 per cent) than of non-science teachers (6 per cent) left teaching during the period 1950-54.

Teaching cannot compete with salary or other attractions with universities, government, and industry for the best science graduates. Comparisons are complicated, but graduate teachers' salaries have probably not grown as rapidly as those in many other occupations. Nevertheless, teaching still draws many university graduates. Salaries for teachers from training college are apparently attractive enough to induce a considerable excess demand for places in training college by qualified applicants. During the period 1955-62, the proportion of training college entrants with two or more "A" level passes increased from 16 to 40 per cent for boys and from 19 to 38 per cent for girls. This marked improvement in entrance qualifications is a result of the growth of the number of school leavers with such qualifications and the much slower growth of university places. The training colleges increased their proportion of all school leavers with two or more "A" level passes from 9 to 14 per cent over the period 1955-61 because the proportion of such school leavers entering university fell from 70 to 57 per cent. The channels by which teaching needs reach the colleges of education are quite direct, since local educational authorities administer both schools and colleges of education. The channel to the universities is hardly less direct, since about one fourth of university graduates enter teaching. Response inevitably lags, however, since training takes time. Plans to expand teacher training and university education must be taken well in advance of needs. There is good opportunity for predicting needs, since pupils enter school at age 5 and are legally required to attend until age 15. Despite the apparent ease of prediction, however, the failure of the expected decline in birth rate to occur in the 1950s led to an underestimate of future teacher needs (as well as physician needs). Response to forecasts requires funds, however, and unless responsible government authority makes the funds available, there is no way for the training institutions to respond on their own.

The efficiency of selection of teachers is quite low in the United Kingdom. While there is a good completion rate among students beginning university and college, there is a substantial wastage. For men the wastage is probably of little importance, since college and university serve a general training function rather than a specific teacher-training function; for women the wastage represents a major loss of resources. To measure how high the wastage is, we may use the targets proposed by the National Institute of Economic and Social Research. To obtain the net increase of 189,000 teachers needed in the period 1965-75, 122,000 men and 67,000 women are needed. To obtain these, it is necessary to train 198,000 men and 330,000 women.

Training cost is relatively high in the United Kingdom, especially in terms of government outlay. To provide annual subsistence grants of several hundred pounds to girls who will teach for only a few years is obviously wasteful when large numbers of qualified male students cannot enter full-time higher education because facilities are lacking.

Other occupations

In addition to the four major occupations discussed above, higher education has the responsibility of meeting manpower needs for technicians, medical workers other than physicians, social workers and business.

The problems of training technicians are closely related to engineering problems. To a considerable degree technicians and engineers are substitutable, although prejudices often lead to the assignment of tasks to engineers that could be performed as well or better by technicians.

In a similar way the use of medical auxiliaries can increase the productivity of physicians as has occurred in the United States. In the United Kingdom, however, the general practitioner is not tied into the hospital-based health centre as is common in the United States, so that the possibilities for substitution and supplementation by nurses, technicians, and social workers is less. The increase of the physician-patient ratio in recent years has made the need to economise on physicians' services less pressing than it will be in the future when the ratio will fall.

The shortage of dentists is a problem of long standing. They are paid as well as general practitioners, but only recently have all training places been filled. In Europe only the Netherlands has a smaller ratio of dentists to patients than the United Kingdom. When the ratio of one dentist for every 3,700 population is combined with the highest per caput consumption of confectionery in the world, the result may very well be the world's worst teeth.

The training of workers for executive and administrative positions in business has only recently begun to receive the attention of universities. Postgraduate business schools at London and Manchester can be expected to provide the kind of sophisticated administrative training that Harvard, M.I.T., Carnegie Tech., and other American universities have long provided. The training of the mass of middle management is likely to remain the property and responsibility of private groups that set the syllabi and of technical colleges that provide the training for the wide variety of diplomas, certificates, memberships and associateships in a large number of business specialties. The specialisation provided in the programme usually begins as early as age 15 or 16, and in some instances the training amounts to little more than the memorising of trade practice, jargon and traditions. I doubt that this degree of specialisation is desirable, or that it can produce enough good to outweigh its probable effect in reducing the rate of innovation and imitation of best practice elsewhere.

VII. Summary and conclusions

If we consider the performance of higher education in terms of decades, we must conclude that higher education in both the United Kingdom and the United States has responded to economic needs. The earnings differentials associated with higher education have shown a secular decrease; the proportions of the labour forces with degrees have increased steadily; the numbers of persons with qualifications in medicine, science, engineering and teaching have grown rapidly. The shortages of particular occupations that require higher education have been temporary except in certain instances where intentional restriction was practised. In terms of shortages definable in labour market response higher education in both countries has served well. This is especially remarkable in that neither system was designed or is currently managed to meet broad economic needs for trained manpower.

If we measure performance by criteria other than those of the labour market, the performance appears at first sight to be unsatisfactory in both countries. Many critics assert there are not enough physicians, scientists or engineers. Unless these assertions lead to spending programmes which create effective demand, however, there is no reason to believe that institutions of higher education should respond to these "needs". The growth of manpower planning in both countries will probably lead to more instances of converting norms into action programmes (as with medicine in the United States and teaching in the United Kingdom). Until this occurs higher education should not be criticised because it does not produce enough people in some occupation. Institutions that are responsive to student wishes (as in the United States) provide the training students want, and institutions responsive to government agencies (as in the United Kingdom) do what the government wants. With few exceptions, failure of American institutions to meet needs results from the unwillingness of students to enter training in the needed occupations, while in most instances failure of British institutions to meet needs results from the failure of the British government to provide funds for expansion.

Some exceptions are worth mentioning. American medical schools have failed to expand because they feared the American Medical Association which has conducted a campaign ostensibly to "improve standards" but in fact to limit entry to medicine. Most schools were prompted to go along with the AMA in this effort because it was easier and money was hard to get, but the medical schools failed to support Presidents Truman and Kennedy, who wanted to provide funds for additional training capacity.

British failures to respond that are attributable primarily to internal decisions and student attitudes are the failures of engineering and dentistry to expand fast enough to eliminate shortages. There were (at least until fairly recently) vacancies for students. The failure to expand higher education, medical training and teacher training resulted from attempts at spending cuts and over-eager response to population forecasts that proved too low.

A striking contrast in attitude toward responsiveness and expansion is observable between American and British academics. Americans are accustomed to responding to the demands of students and employers. Many do not like it, but believe the only possible alternative is to be responsive to government planning which they like even less. They also usually accept the idea that "more means worse", but they often believe their own institution is getting better. Many British academics act as if they were autonomous, but in fact the UGC exercises a considerable degree of control over salaries, subjects and programme costs. Many British academics believe more inevitably means worse.

It is possible for British higher education to expand rapidly without a reduction in quality of education, but the new students must be drawn from the able children of working class parents. To do this may require a change in the system of student aid. The large dropout among the most able working class children occurs between "O" level and "A" level.

The lack of money for expansion has strikingly different effects in the United Kingdom and in the United States. Expansion occurs anyway in the United States, but quality suffers. If we consider that the Federal government made no important financial contribution to higher education, the expansion of the postwar period and the improvement in the quality of

many institutions appears quite remarkable. But choice is the student's. He picks his course, and departments must cater to his wishes. Most American students want a general education and do not want to specialise. Many want to change majors and careers in the middle of college.

The lack of money for higher education in the United Kingdom restricted growth during the 1950s. The proportion of qualified school leavers entering higher education has fallen over the past decade, and the proportion entering university has fallen even more. The surplus of potential students made it possible for a university to get students to fit the courses it wished to teach. In turn, this has led the government to consider that the courses offered should conform to economic needs rather than academic whims.

The expansion of higher education in the United Kingdom is not likely to occur fast enough for there to be a surplus of places, but the competition for good students will always be present. The attraction of general first-year courses appears to be considerable, and this suggests that many British students want more general education. The growth of joint honours courses after general first years seems inevitable. In one new university 30 per cent of the students changed the subjects they intended to read after a general first year. The growth of general education on the pattern of joint honours degrees is a form of response to economic needs. It is in business and in teaching that demand for non-scientific graduates is likely to be greatest in the coming decades, and for these areas general education is often more suitable than highly specialised education.

The problem of responsiveness to training needs is political and financial. In the past, American universities responded to the desire of students, state governments, and donors to spend on specific subjects. In the United Kingdom only one man could decide to spend more on education: the Chancellor of the Exchequer. As a result, in coming decades the United States must live with manpower shortages resulting from its failure to plan for the educational needs of the economy. The United Kingdom must live with the results of its inadequate planning.

In the future much of the power of decision and responses in the United States (as now in the United Kingdom) will be in the hands of government. The increasing places in higher education consistent both with manpower needs and with the wishes of students must be better planned than in the past. Planning must be more responsive to general long-range economic plans and must be continually revised in the light of new developments.

SOME ASPECTS OF THE OPERATION OF THE
LABOUR MARKET FOR HIGHLY QUALIFIED
PERSONNEL

Summary paper prepared by the
Secretariat of OECD on the basis of studies by
the Manpower and Social Affairs Directorate OECD and
L. Levine, formerly Director of the United States
Employment Service

I. The role of the public employment service in the labour market for higher level occupations

Introduction

The paper deals with the labour market in ISCO groups O (Professional, Technical and Related Workers) and I (Administrative, Executive and Managerial Workers), and with new entrants who might reasonably enter these groups, i.e. those with education beyond the normal secondary school. It is based on material supplied by the authorities in France, the Federal Republic of Germany, the Netherlands, Sweden, the United Kingdom and the United States.

The groups concerned have certain characteristics which distinguish them from the majority of the population. In general they have more to give to, and demand more from, their job and represent a bigger investment in training both by the community and the employer. The geographical spread of the labour market is much wider and more knowledge is needed to evaluate their qualifications. These qualifications in turn may be the result of formal education or experience or a mixture of the two, and it is a valid question to what extent these elements are interchangeable.

Mechanisms of the market are (a) formal (b) informal. The former include:

(i) The Public Employment Service;

(ii) Appointments services run by professional associations for their members;

(iii) Appointments services controlled by educational establishments;

(iv) Fee-paying private agencies including management consultants.

The latter consist largely of press advertisement and personal recommendation.

The public employment service

In all six countries there is a free government-controlled service which carries out placing operations, the great majority of which concern occupations below the level we are discussing. Nowhere is registration by the applicant or notification of vacancies by the employer compulsory, although in Germany and Sweden the public service has a near monopoly of formal placing activities. It is necessary here to consider how the service for the groups we are considering differs from that given to lower-level occupations by the ordinary network of local offices.

Organisation

Th mal system in the European countries is to devote to this wor ns of the regional head offices or of the larger local off there are quite small central offices for high level pe , Frankfurt and the Hague. The United States has spec in ten large cities with a nationa learance system linking ordinary local offices in respect of their professional and managerial vacancies only. Also, in Sweden and the United States there are separate administrative sections at Headquarters dealing with problems related to these groups.

Thus all countries have found it necessary to set up special units of some kind, usually with improved premises, because of the social prejudices of the applicants, the geographical spread of the market, and the higher quality of staff required. The degree of specialization is most marked in large centres of population and is based on occupational and educational rather than industrial criteria. A problem here is that whereas large units covering wide areas tend to find it difficult to give the appropriate personal attention to each case small ones, on the contrary, cannot be allocated sufficient high quality resources.

Level

Everywhere the number of placings in really top level positions is low; only at the Frankfurt special office can it be said to be significant. The usual traffic is in occupations towards the lower end of the groups concerned. All countries experience great difficulty in placing the unemployed older executive, and it is feared that this task, which is peculiar to the public service, is likely to increase with technological change.

New entrants

The service deals with these everywhere, usually in active co-operation with the educational authorities. The special units mentioned above are entrusted with this duty in theory but there is a tendency for ordinary local offices to take a greater share of the interviewing. Work with new entrants has a three-fold importance: to the applicant in that he has access to authentic nation-wide and unbiased information, to the community in that an objective attempt is made to place expensively-trained manpower where it will be used to the best advantage, and to the service in that the opportunity of offering good new raw material increases its prestige with employers.

Methods of work

These are generally the same as for the service in general; the principal characteristic of work with the groups concerned is the high degree of individual treatment necessary. We may note:

(i) Information gathered from the applicant is more comprehensive, and the original form which is the basis of the file is usually completed by the applicant himself, so that at the employment interview more time can be devoted to personal discussion. Advice is an important feature, especially with new entrants.

(ii) More data are acquired about the vacancies, and more systematic follow-up of submissions carried out. The specification of a job order often changes during its currency and many referrals may be necessary. There are special programmes for making speculative submissions of applicants to possible firms, usually through the issue of lists or booklets containing particulars of promising candidates.

(iii) Wide clearance facilities are a feature of the public employment service and the exploitation of this calls for efficient methods of communication. Usually copies of application and vacancy forms are exchanged between offices and often also applicant and vacancy lists are compiled and circulated. When total numbers are small, the former method has the advantage of flexibility and ease of amendment, but otherwise lists are economical, need no sorting, and if printed can be used for issue to the public as well as internally by the staff. In four countries telex is used between offices, and in Germany for communication with certain firms also.

(iv) An experiment has been made in the US to link the telex system with a computer so that job and applicant information fed in from a distance can be classified and compared overnight.

(v) All countries make some attempt to use television and radio, but in every case expense limits the extent to which this can be done. Its value is recognised as a matter of policy, especially in the US.

(vi) All labour market authorities are responsible for the publication of manpower statistics but nowhere are these designed so as

to be of benefit not only to the outside economist but also internally to the service. Information properly classified by occupation and level would be invaluable for practical use by counsellors and placing officers.

Staffing

The high degree of individuality of work with higher-grade personnel (more detailed information, importance of advice, number of submissions) is directly reflected in the greater amount of staff-time needed for each case. This is recognised by the countries and, in Germany, Sweden, the United Kingdom and the United States, more generous work-load coefficients are allowed.

Except at the special office in Frankfurt, where only staff with academic or technical qualifications are in post, the officers on higher-grade work are not of a different category of education from the others. The general opinion is that such duties are within the competence of the best of the ordinary experienced staff. It would seem, however, that for success in this field ability to deal on equal, or nearly equal, terms with both applicant and employer is a necessity, and if staff with only the usual secondary school education are to be employed then a fair amount of specialized in-service training is called for. However, nowhere does such training consist of more than short courses, and it may well be asked whether in the circumstances these are sufficient to give the wide range of knowledge (about labour market conditions, professional requirements, and psychological characteristics) required of an officer dealing with higher-grade personnel.

Salaries for officers engaged on this work tend to be slightly higher than for the other placing staff. Only in the Netherlands, however, are they thought to compare reasonably with those engaged on not dissimilar duties in private industry.

Allocation of resources

Ultimately the amount of resources allotted by the service to work in this field depends on the importance in which it is held re total available. The two main considerations are:

(i) Economic: the necessity of deploying valuable human ability to the best advantage.

(ii) Social: the importance to the individual of advancement via change of employment, and his right of access to free and authentic information and advice when making a choice.

However since this work is very time-consuming and therefore expensive it is a vulnerable target for economy measures when extraneous political pressures are put on the public employment service to cut down its expenditure; during the fifties all countries could show examples of this.

Other mechanisms of the market

(i) Appointments services run by professional associations

These are not significant in Germany, Sweden and the Netherlands, and in the first two placing activities by them are allowed only after authorization by the public employment service authorities. In France, the UK and the USA, however, they are important.

(ii) University Appointments Boards and similar bodies

The same applies. There are such boards in the Netherlands but they are especially important in the UK and USA.

(iii) Private agencies operating for profit

These are forbidden in Germany, the Netherlands, Sweden and France, although in the last country the law is hardly enforced. They are important in the UK and the USA and often penetrate to the top levels there. Management consultants performing placement work under cover of their principal activities are flourishing everywhere, for even in the countries where this is legally forbidden it is difficult to prevent.

(iv) Informal means

Advertising, in both the public press and professional journals, and personal recommendation are all countries, even those where the formal mechanisms are most highly developed, much the most important mechanisms of recruitment for the groups we are discussing, and this trend seems to become more pronounced the higher up the occupational ladder one goes.

Conclusions

In all developed countries there has been a vast growth in technical education and employment. At present this expanding labour market is served largely by informal mechanisms. How far the public employment service should seek to penetrate it is a policy question to be decided on economic, social and administrative grounds, but it is certain that if it is to do so effectively everything hinges on the allocation of sufficient resources. There is no magic formula; the secret of success lies simply in the provision of a high quality staff in adequate numbers with modern facilities and enough time to devote to their work.

II. Placement mechanisms for highly-qualified personnel in the United States

Introductory remarks

Mr. Levine, who considers that a more satisfactory title for this paper would be "Economic Considerations for the Utilization of Highly Qualified Personnel" confines his subject to those qualified in science and engineering, and executives formulating policy decisions which affect those so qualified, in the United States of America. He stresses the difficulties caused by anomalies in occupational classification and the general paucity of information in the field, leading to the drawing of conclusions from inadequate data.

Manpower significance of present day science and technology

Modern standards of living are based on technology, and the prestige of the scientist and engineer increases with the economic development of the country employing them. The time interval between the discovery and exploitation of any scientific invention is steadily decreasing.

Some of the highest returns on capital are found in education, but the initial cost of the investment is high and the period of realization long. Growth in such expenditure has been massive over the past twenty years.

The specialized knowledge of the scientist or engineer is needed to assist those responsible for administration, yet the combination of technical and managerial skill is difficult to find. It has been said that the scientist is ill-equipped in the exercise of leadership; this has led to the view that his education and training should be broadened.

Employment and allocation of highly-qualified personnel

There has been a marked increase in employment of technical and professional workers since the war. This growth is attributable to policy in the public sector rather than the normal civilian market forces. Not only does the government employ a substantial number of scientists and engineers directly but by financing research and development on a massive scale controls the greater part of those elsewhere. This support is overwhelmingly in favour of applied research and development, and may be distorting the true function of the universities by inducing academic staff to leave basic research and teaching.

Private industry is generally more generous with both salaries and expenses than teaching and government service, in which the security of tenure is no longer the attraction it once was. Government service is often used as a stepping-off point for the young graduate and leads to a high turnover there among those with a few years experience.

Despite the general upward trend of employment, there have been fluctuations and even some layoffs. Aerospace, on government contract, is especially vulnerable and three years ago many aeronautical engineers, until then in high demand, were suddenly displaced. It was found in this case that the most highly sophisticated technologists were the most difficult to replace, and that other employers preferred new recruits or men with

more general experience; former defence workers were unpopular with commercial firms not only because of over-specialization but also because of lack of cost-consciousness and an acquired disinclination to tackle difficulties positively.

Determining the supply of professional and scientific manpower

The subject is prominent in public discussion. Supply is usually assumed to be insufficient, but there is little positive evidence that this is necessarily so. It varies widely according to place and time.

The content of education tends to be determined by student preconceptions and pressure from the central government rather than by economic factors. Young people may be deterred from entry to scientific and engineering professions by rumours of insecurity of employment and of the lack of a proper ladder of advancement. Better vocational guidance at elementary and high-school level is called for - lack of it may have contributed to the recent high numbers of dropouts in subsequent higher education. Counsellors would be greatly assisted by the provision of manpower estimates properly classified by education and level.

The long period of training permits an estimate of the numbers likely to graduate but also prevents the meeting of short-term deficiencies by expansion of education. The position is further complicated by the likelihood of completely new professions arising between the traditional disciplines.

Nature of requirements for professional and scientific manpower

Since most requirements are determined by policy in the public sector ordinary considerations of supply and demand are not relevant. Professional societies, when consulted, have tended to overestimate the demand. Overestimating is also caused by firms concentrating on the recruitment of new graduates and paying insufficient attention to the possibility of retraining and reallocating existing staff.

In spite of the difficulties, attempts to estimate requirer[illegible] being made. Those for the long-term are usually based on forecasts of economic growth on the one hand and demographic projections on the other. The major defect of this approach is that it is so broad as to allow wide error in specific cases. Moreover, since normal movements of the market economy and consumer spending have little meaning in such fields as aerospace and defence, recourse is necessary to analysis of past experience followed by intelligent guesswork.

Whilst it is accepted that many imponderables, such as changes in the international situation and unforeseen developments in basic scientific thought, exist to upset calculation of estimates, the government should collect and disseminate more detailed manpower information and require its own departments to prepare detailed estimates of requirements, giving due consideration to both their own needs and those of concerns under their financial influence. This would greatly increase accuracy and serve as a model outside the public sector. Better techniques of collection and analysis of manpower information are essential if trends are to be discerned and margins of error narrowed.

The market and placement mechanisms for scientists and engineers

The methods by which high-level people find jobs are haphazard. Traditional concepts of work and vocation shape their behaviour and their attitude to such matters as mobility and use of bargaining power. In an academic environment even the access to employment information is guarded.

Mechanisms are largely informal, although there has been a slight trend towards the use of formal means on the part of employers. Concern for the preservation of professional dignity leads the applicant to avoid the appearance of urgency in his search at all costs.

Formal mechanisms have not expanded in step with the increase in higher education. Essentials for success on their part are the maintenance of confidentiality, opportunity for face-to-face interviews, nation-wide clearance.

Placement mechanisms for new graduates differ from those for experienced staff. Activity for the former is centred on the campus, with college placement officers, individual professors and recruiters working directly for employers playing the largest role.

Other means of recruitment are advertising, private agencies (fees paid by the firm) and directly on introduction by those already employed. The public employment service, though used mostly by the unemployed, is nevertheless the fastest growing of all formal mechanisms. In general it may be said that there is too much labour-piracy and unnecessary turn-over, which precludes the taking of genuinely constructive steps such as increasing the number of supporting staff and re-allocating duties among those already in post.

Policies and programmes for utilization of professional [illegible]fic personnel

Many scientists and engineers are not being used to the full extent of their capabilities, to the disadvantage of both themselves and the community.

The first form of misuse is the denial of opportunity for employment or progress for reasons unrelated to competence or performance. Obvious examples are discrimination because of race or sex. The second is unemployment. Dislocation in high level occupations is especially serious because (i) it is a waste of a very high cost investment, (ii) it brings disproportionately high personal hardship as a result of the wide gap between previous salary and insurance benefit payable and (iii) the spectacle of it discourages young people from entering the profession concerned. Engineers and scientists are often unemployed for long periods if their experience has been narrowly specialized.

The third is under-employment, usually taking the form of assigning to the professional man duties which do not require the exercise of his knowledge and ability.

Management is immediately responsible for the recruitment, assignment, motivation and ultimate realization of potential of its personnel. It is important that (a) appropriate duties be correctly apportioned between technologist and technician. The lines of demarcation are changing and the ratio between the two varies from industry to industry. The distinction should be based on duties rather than qualifications; and (b) the dangers

of overspecialization, leading to technical obsolescence, are recognised. Very common in defence industries, the latter shows up everywhere in the competition between the new graduate and the experienced man.

The professional associations can assist by insisting on seniority and retraining provisions and by paying special attention to the problems of technical obsolescence. They have been active in fixing standards of qualification but too often have been open to the charge of not being sufficiently sensitive to the interests of their members, especially in times of economic difficulty.

The universities should sponsor a creative approach to re-education, in the development of programmes, techniques and teaching staff, and also to the problem of making initial education sufficiently adaptable to meet subsequent changes in technology.

The Federal government acts as employer, awarder of contracts, and provider of direct services. As the largest single employer it has ample scope for influence by good example in management practices. The second function is paramount, and unfortunately there is little evidence that manpower considerations are taken seriously. The system of contracts, coupled with unbalanced support of applied research and sudden changes in defence policy, induces firms to overspecialize and to keep reserves of qualified staff on duties below their capacity, thus contributing to both the manpower deficit and technical obsolescence. In the award of contracts, due consideration should be given to the location, diversification of activity, and personnel policies of the firms tendering. Programmes should be planned in the long-term (as recommended in a recent report of the National Academy of Science) and contractors warned of coming changes.

Actual measures which could be undertaken by the government directly, through the public employment service, include, besides the improvement of placing procedure, provision of improved access to comprehensive information on employment opportunities and of facilities for expanding labour mobility and assistance with household removal.

The last item in particular is an area in which the public service must give the lead. It has a unique advantage in its nation-wide coverage. Also some form of assistance in relocation (e.g. payment of removal expenses and loans for house purchase) may well be appropriate to government intervention, especially since the government stake in this field is already so large.

Traditional US concepts lay emphasis on the importance of free choice and private enterprise. There may be room for disagreement how far the government ought to act directly. However a lead in the establishment of more rational market mechanisms must be given and it would seem an appropriate government responsibility to undertake this.

THE PROGRAMME OF POSTCENSAL STUDIES OF PROFESSIONAL AND TECHNICAL MANPOWER IN THE UNITED STATES

by Robert W. Cain
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I. Background and content

The need for data on the Nation's resources of all types of manpower has become more urgent as an awareness grows that such information is vital in planning and evaluating many economic, educational and scientific policies and programmes in all sectors of the economy. In particular, the concern regarding resources of high-level manpower required to carry out the multitude of tasks in science and technology has been reflected in the National Science Foundation's programmes of scientific manpower studies. These programmes have been in effect since the establishment of the National Science Foundation more than a decade ago, and, although the number and variety of studies and surveys supported by the Foundation in recent years has been quite extensive, the realisation that there is yet much to accomplish is present at all times.

The genesis of the Postcensal Studies Programme goes back to 1957 when the Foundation, together with the President's Committee on Scientists and Engineers, appointed a special advisory panel to review requirements for scientific manpower data. In its report (1) issued in 1958, this panel found, not surprisingly, that on the whole, data on the

(1) "A Program for National Information on Scientific and Technical Personnel", NSF 58-28, National Science Foundation, 1958.

number, demand, supply, utilisation, and other economic and social characteristics of scientific and technical personnel were not adequate for formulating policies and undertaking programmes related to the welfare and security of the Nation. Among the projects recommended as highly urgent was "a special survey of a large sample of persons recorded in the 1960 Census enumeration as college graduates or as persons currently or last employed in scientific and technical positions, whether graduates or not, to determine relationships between training and subsequent occupations". It was reasoned that the 1960 Census would provide a rare opportunity (not available again for possibly another 10 years) to obtain valuable data directly and efficiently from the individuals classified in scientific and technical occupations regarding their demographic, economic and social characteristics. In addition, by surveying all types of college graduates, regardless of occupation, comparable data would be provided on other highly trained personnel in other professions (such as law and medicine), in the humanities, in business, and in managerial and administrative positions in business and government as well as those currently not in the labour force.

With the knowledge that Census Bureau data processing would have available by 1962 a tape with the occupational sample information, the National Science Foundation in 1960 began to consider the feasibility of undertaking such a major project, and requested that the National Opinion Research Center, affiliated with the University of Chicago, prepare a planning statement on a series of postcensal studies of scientific and professional workers and college graduates. A detailed planning statement was prepared which provided the initial basis for the proposed studies. During the first part of 1961, the Foundation, aware of the interests and missions of other Federal agencies, initiated a series of meetings with these agencies to acquaint them with the proposed studies and provide them with the opportunity to participate in or co-sponsor the nationwide survey under consideration. By late autumn, 1961, four other Federal agencies - the US Office of Education, National Institutes of Health, Bureau of Labour Statistics, and the Veterans Administration - had made definite commitments to participate in the survey and provide the necessary support.

Beginning in the spring of 1961, the National Opinion Research Center with the aid and consultation of the National Science Foundation and the Bureau of the Census began to develop a basic mail questionnaire which would be used as the primary survey instrument for the Postcensal Studies Program. The mechanics of the survey, including sample selection, pre-testing, data collection, processing and tabulation are described below. Therefore, the content of the questionnaire will be discussed in the remainder of this section.

The availability of a large sample based on the entire population was a very attractive possibility for requesting information on an extremely wide variety of subjects which could well have covered numerous economic, demographic, sociological, and psychological areas. The temptation to run wild, so to speak, was held in check by the very obvious realisation that the burden imposed on the respondents might be such as to obviate any possible success in obtaining a meaningful rate of response. In addition, of course, was the fact that the Foundation's programme of manpower studies, and those of others, provide data from a variety of sources, much of which would both complement and supplement

data derived through the Postcensal Studies Program. These manpower studies include, among others, the National Register of Scientific and Technical Personnel, employment surveys of scientific and technical personnel in various economic sectors, follow-up studies of college graduates, and pilot efforts dealing with the labour market behaviour and mobility of persons in selected occupations.

Several major classes of people comprised the universe included in the survey. The largest class consisted of persons who were reported as being in the experienced civilian labour force in specified professional occupations in the 1960 Census (1). This included those who were employed in the specified occupations and those who were unemployed, but whose last job was in one of the selected occupations.

The original planning called for 33 professional occupations. Three of these were dropped (2) before the survey was taken, whereas librarians were limited to those employed in public libraries and elementary or secondary schools, and sampled as separate groups. Thus there were 31 distinct professional categories in the survey. These are listed in Table 1.

A second major class included in the survey comprised those persons in the "experienced civilian labour force" in seven technical occupation groups. The occupations included were designers, draftsmen, surveyors, medical and dental technicians, electrical and electronic technicians, other engineering and physical sciences technicians, and technicians not elsewhere classified.

In addition to the two major classes of occupations listed above, the survey included a sample of persons who had completed four or more years of college. This last major class was subdivided into the following groups. The first three groups were in the labour reserve (3) in 1960. The three labour reserve groups covered:

1. Female, ages 20 to 54 years, with experience in one of the selected professional or technical occupations;

2. Other persons with experience in one of the selected professional or technical occupations;

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(1) For information on the classification of occupations in the 1960 Census, see U.S. Bureau of the Census: "1960 Census of Population, Alphabetical Index of Occupations and Industries", Revised Edition, Washington, D.C., 1960; and its companion volume, U.S. Bureau of the Census: "1960 Census of Population, Classified Index of Occupations and Industries", Washington, D.C., 1960. For information on the definition of concepts used by the Bureau of the Census, see the text in the following reports: "U.S. Census of Population: 1960, Detailed Characteristics, United States Summary", Final Report PC (1)-1D, Washington, D.C., 1963; and "U.S. Census of Population: 1960, Occupational Characteristics", Final Report PC(2)-7A, Washington, D.C., 1963.

(2) Professional nurses, phamacists, and physicians and surgeons who were employed by any level of government, but not working in hospitals.

(3) In the 1960 Census the term labour reserve was used for those persons who had worked sometime during the period of 1950 to 1960, but were not in the labour force at the time of the Census.

3. All persons in labour reserve with experience in occupations not selected for the survey.

The persons in the "experienced civilian labour force" who were in occupations other than those selected for the survey were subdivided into the following three groups:

1. Managers, officials, and proprietors (not elsewhere classified) who were working in the following industries:
   - Agriculture, forestry and fisheries;
   - Mining;
   - Construction;
   - Manufacturing;
   - Transportation, communications, and other public utilities;
   - Entertainment and recreation services;
   - Professional and related services;
   - Public administration.
2. Balance - Females, ages 20 to 54 years
3. All others.

The remaining group consists of the remaining noninstitutional population, 20 years old and over, not in the Armed Forces.

The content of the Postcensal Studies Program can be reviewed in some detail through an examination of the survey questionnaire itself. Even with self-imposed limitations, the final version of the basic questionnaire ran to eight "full-packed" pages with an additional sheet enclosed containing a list of pre-coded fields of specialisation to be used in answering questions dealing with employment and training. Three variations of the questionnaire were designed and used in the survey. The basic questionnaire was used for the selected professional occupations, and the three "experienced civilian labour force" classes. A variation of the basic questionnaire was used for the technicians. The major changes in this questionnaire were in the list of job activities, and the technicians were not asked work attitudes. A second variation of the questionnaire was used for the labour reserve and the last class of those not in either the labour force or the labour reserve. The major difference in this questionnaire was in the method of asking for past work experience.

A supplementary questionnaire was sent to a portion of the biologists and psychologists concerning any sources of research support they may have received during their graduate studies.

To begin with, among the main foci of interest were questions pertaining to the employment, occupation, and job activities of persons classified in selected professional, scientific, and technical occupations during the 1960 Census. In the 1960 Census schedule, the amount of information available pertaining to a person's work activities is quite limited. In fact, the only direct questions deal with what a person does (in terms of an occupational classification) and what type of employer he works for. Even information collected by both government and non-government organisations for studies dealing with job analysis or vocational guidance have largely provided some general outlines when dealing with professional and technical personnel. The occupational label, used in classifying personnel, such as "engineer", "chemist", or "college professor" actually covers persons in a wide range of specialisations.

Therefore, there was interest in determining first, for the most current period possible, how many engineers, for example, were working in civil compared to nuclear engineering?; how many chemists considered themselves to be in organic chemistry compared to physical chemistry?; and, what fields college teachers considered their primary area of specialisation? Beyond this, there was hope of obtaining some insight into the extent to which interdisciplinary work in science and technology has resulted in engineers working in an area of the physical or life sciences, physicists concerning themselves primarily with some aspect of the medical sciences, or mathematicians calling astronomy their field of work specialisation.

Another equally important area of job information concerns the activities or duties actually performed; that is, what do people classified in professional and technical occupations of interest to us "really do" in their jobs. Most of the information in this area, up to the present time, comes from other surveys which give only an indication of the functions in which an individual is primarily engaged; for example, the National Register and the employment surveys mentioned earlier. Although there is some indication that a certain number of physicists may be involved in "research", what the varied job requirements or duties of these personnel are in total, has not really been known. In addition to obtaining an overview of the varied activities making up the jobs of professional and technical workers, respondents in the study were also requested to indicate which two activities were primary in the sense of the most time being spent on them.

In order to obtain an understanding of the organisation of work in professional and technical occupations and the inter-personal relationships in the work environment, a series of questions were directed at the respondent regarding the size of the organisational unit in which employed; the number of employees being supervised, if any; whether he works as part of a team, either with personnel from his own field of specialisation or from others; whether he has an immediate supervisor, and, if so, if the supervisor's field of specialisation is similar to his.

It was also determined that some insight into the process over time by which such highly trained persons are allocated to various jobs and employers would be helpful in dealing with an assortment of problems including the supply and demand of scientific and technical personnel. To this end, questions on employment and job activities were related to three points in time-current employment (e.g. mid-1962 when the survey schedules were sent out), April 1960 (the date of the decennial census when the persons in these occupations were originally enumerated), and the first fulltime job held at age 24. It was obvious, of course, that such information could not provide complete work histories, but would give a broad overview of mobility patterns. For these time periods, it is possible to analyse many factors in relation to changers and nonchangers among the various occupational groups.

Turning now to the third main area of inquiry, training, an intensive effort has been made to obtain a considerable amount of detail on various facets of both formal education and informal types of training. By and large, persons in the occupations covered in this survey have a fairly high level of training, especially when compared to the general population.

To begin with, since information on training was obtained as of 1962, it was possible to update the Census occupational information on

the number of years of formal training completed. However, the primary interest lay beyond this data, in that we wanted to determine some of the specifics of higher education obtained in relation to subsequent employment. Data was therefore requested on major fields of specialisation for undergraduate and graduate study at every institution attended, as well as the different types of degrees granted, where appropriate. As a subsidiary question, information was requested on sources of financial support received by respondents for undergraduate and graduate or professional training. In addition, because of the general knowledge that a substantial amount of training takes place outside of the formal educational system, several questions were included about informal types of training received, such as company training programmes, military training applicable to civilian occupations, home study, correspondence courses, special workshops and seminars, etc.

Lastly, as previously indicated, some information was sought on background and personal characteristics both to supplement data available from other sources and as factors to relate to data obtained in the areas dealing with employment and training.

The information obtained in several of these areas includes: (1) attitudes toward work in terms of the respondent's current occupation - respondents were asked to indicate the relative importance of, and degree of satisfaction with, selected characteristics of occupations. (2) Marital status and fertility - this includes both the marital status of the respondent as well as the number and ages of the respondent's children as possible factors in job mobility. Also, we are provided with a measure of the reproductive rates of an important segment of the population. (3) Professional characteristics - this area covers membership of professional associations and data on the publication of articles or books and presentation of papers at professional meetings. Obviously, these two characteristics are only a few of the many which could be explored regarding status or professionalism among the occupations being studied.

As mentioned above, a second major group covered in the Postcensal Survey encompassed a sample of all college graduates broken into a number of subgroups. For all these respondents, information was also obtained on their work and career histories, training background, and various personal characteristics.

II. Data collection, processing, and tabulating

The Postcensal Study of Professional and Technical Manpower represented a major effort in terms of data collection, processing and tabulation. Most of these functions were undertaken by the Bureau of the Census with the advice and guidance of the sponsoring agencies. Among the major tasks involved in this study were:

1. Design and printing of questionnaires and other forms;
2. A pretest covering 600 cases;
3. Sample selection of some 70,000 persons covering 45 specified professional and technical occupations and college-graduate groups

from the 1960 Census of Population records. The complete list of 45 classes and the detailed components are outlined in Table 1;

4. Matching of selected sample cases with the 1960 Population Census schedules to obtain name and address for mailing purposes;

5. Mailing operation consisting of an original mail-out, follow-up as required by two reminder letters and, finally, a reminder letter under the National Science Foundation letter head;

6. Independent subsampling of the two classes of non-responses — (1) those returned by the post-office as nondeliverable, and (2) those apparently delivered but not answered. The two groups were subsampled for further follow-up by, respectively, (1) addressing new questionnaires to the "postal rejects" in care of their employers (requiring a search and match of the 1960 Census of Population returns for "names of employers" and a directory search for the corresponding address) and (2) having the "nonanswer" cases telephoned by Census Bureau enumerators in the areas covered by the Current Population Survey;

7. Manual editing and coding of the returned questionnaires;

8. Card punching the information (requiring six punch cards per case);

9. Transfer of punch card data to computer tape;

10. Preparation of the computer tape record for each case and weighting of same;

11. Tallying the required tabulations.

Pretests. A feasibility pretest of this survey, covering 275 cases, was conducted in the Chicago area by the National Research Center. Another pretest was conducted by the Bureau of the Census beginning in the autumn of 1961. Persons in professional and technical occupations used in this survey were selected from a special evaluation project file which provided the names and addresses of respondents. Approximately 600 cases were selected for the pretest. An original mailing was followed by two reminder mailings sent to the nonrespondents. The response rates of this pretest are given below.

	Number	Responses	
		Number	Percent
Total.	591	419	70.9
Original mailing	591	254	43.0
First follow-up	445	116	26.1
Second follow-up	229	49	21.4

A subsample of the nonresponse cases, amounting to 51 cases, was drawn for further follow-up activity. This work consisted of a personal phone call reminder to the nonrespondents. This produced 23 additional returns. Therefore, the final number of completed questionnaires received in the pretest was 442 or 74.8 per cent (A figure quite similar to the results in the main study).

These completed questionnaires were then analysed and tabulated focusing on the problem of nonresponse by item and inconsistency between items. The result of this analysis was the final determinant in preparing the format and wording of the questionnaire.

Sample selection. The Bureau, in consultation with the sponsoring agencies, selected the sample for the survey. First, within the limits of financing and statistical reliability, the number of sample cases required for each occupation and other group in the universe was determined (see col. 1 of Table 2). Estimates were made - since the universe counts were not yet available at the time - of the number of cases of each of these groups that would appear on the 1960 Census 25 per cent sample tape file. These two figures provided the basis for determining a differential sampling ratio for each group to supply the required number of sample cases (col. 3). Since the basic universe was not known but had to be estimated, a very liberal sampling ratio was adopted to ensure that a sufficient number of sampling cases would be selected from the Census 25 per cent sample file. Using these sampling ratios, the first selection (and count of the total in each category) was made by the computer on a sample "every K case" basis. The computer identified and selected by the predetermined sampling ratio each category of the sample universe (shown in col. 4).

Revisions in the groups to be surveyed were also made. Such revisions in the groups were cause for increasing the number of sample cases required for certain of the remaining groups (col. 2). The revised number of sample cases required for the study was then compared to the first sample selection based upon the liberal sampling fraction. A division of these two figures for each group provided a subsampling fraction (col. 5). The computer then applied the subsampling fraction to the first sample selection and selected the final sample (col. 6).

The computer thus identified the sample cases and also selected, for high-speed printouts, pertinent data for the sample case, providing a basis for searching original Census records for purposes of matching, and name and address determination for mailing the questionnaires.

The subsample of 1,500 biologists and 1,000 psychologists was selected to receive the supplementary questionnaire on research support. These cases were selected by using a random start and every "n" th case thereafter.

Matching and mailing operations. When the sample was selected from the 1960 Census tapes, certain identification items were selected for each case and printed out on a listing. Some of the identification items used were the codes for State, county, enumeration district (ED), occupation, industry, age, and highest school grade completed. Each case was also assigned a control number. With this information the Census schedule books were searched to ascertain the name and address of the individual.

At the same time as the names and addresses were being located, punch cards were being prepared for control purposes. These cards noted the control number, State, and a code indicating the type of questionnaire required. The name and address, as ascertained from the n of Census records, was also typed on the card. This typed address was reproduced by a Xerox process and used for the address labels. The card itself was used for check-in control (those not showing a notation of receipt of schedule being sent additional mailings as required).

Although there were 45 independent samples comprising the survey, they broke down into three major components for purposes of schedule design and into four separate groups for purposes of the mailing operation.

The mailing operation consisted of an original mailing and three follow-up mailings. The mailouts were divided into four groups as determined by the respondents' status in the 1960 Census. The first group represented selected professional workers in the labour force (excluding 2,500 biological scientists and psychologists).

All biological scientists and psychologists were sorted from the professional group described above. The sample of about 1,500 biological scientists and 1,000 psychologists was then merged into one group. The portion of the biological scientists and psychologists not selected in the sample was returned to their original file.

Another group consisted of those persons with technical occupations. The last group was composed of the labour reserve.

The mailing pieces to each of these groups consisted of (1) the respective questionnaire, (the biological scientists and psychologists also received a supplementary questionnaire), (2) an introductory letter, (3) a "Fields of Specialization List", (4) a return envelope.

Receipts. The endeavours described in the mailing operation elicited 51,505 completed questionnaires from the original panel of 71,300. The rate of receipt amounted to 72.2 per cent. This figure compares favourably with our pretest experience where the return rate amounted to 70.9 per cent.

Variations in the categories may be noted in Table 1. (This table shows rates of receipt by each of the 45 classes). For the professional group, the highest receipt rate was achieved, amounting to 72.6 per cent, whereas the technical worker group - somewhat under the average return rate - amounted to 63.9 per cent. Among the professional workers, it may be noted that the highest return rate is 82 per cent (foresters and conservationists).

Field follow-up procedures. About 12,500 of the original cases did not respond to any of the four original mailings and constituted the "non-answer" file of nonrespondents. This group was sampled at approximately a 1 in 4 rate for personal follow-up. Thus about 3,000 cases required follow-up, all of which, by design, fell into Primary Sampling Units of the Bureau's Current Population Survey and thus an existing field staff was available to implement the procedure. The field interviewers contacted each nonrespondent by telephone, asking them to complete a questionnaire. Those cases indicating co-operation were mailed a questionnaire by the interviewer, along with a Regional Office return envelope. Those cases indicating a refusal to complete a questionnaire were asked eight basic questions on the phone. Nonrespondents to the questionnaire sent by the interviewer were called and asked the eight basic questions.

In regard to the "postal reject" file (the group never delivered by the post office), amounting to 7,100 cases, a sample of 1,000 random cases was drawn. A further attempt to locate these cases was made through their last known employer. Since the 1960 Census results provided the name of the employer, we had a basis for operation.

The address of the establishment was obtained by checking through city directories and other reference material. The questionnaires were then mailed to the respondent in care of his employer using the normal mailing procedures with provision made for the follow-up mailings. These activities resulted in a return rate of about 30 per cent.

Coding and editing of schedules. The processing work was accomplished by dividing the work into two major portions, namely "General Coding" and "Occupation and Industry Coding". The schedules were designed to minimize coding by annotating the entry boxes where possible with predetermined punching codes. Where this was not possible, as in the cases of "institution attended", "type of degree granted", "name of sponsoring institution", "subject of training", and "State and county of residence", codes had to be predetermined and, as in the case of "subject of training", a three-digit code was formulated and a special publication prepared noting the subject field content of each broad three-digit field. Also, during the "General Coding" phase, extensive editing rules were applied to the items to account for some blanks, obvious inconsistencies, consideration of fractions, improper placement of entries, dual entries, finding midpoints of ranges (if given), conversion of income entries to codable items, conversion of improper time basis to acceptable basis. Further editing of this nature was also implemented in the computer.

The "Occupation and Industry Coding" phase of the work was done in accordance with the 1960 Census of Population classification scheme, with some minor modifications. All clerical work was verified completely on a dependent basis.

Preparing the record and weighting. Prior to tallying the tabulations in the Postcensal Study, certain programming activities were required to prepare the computer tape record.

Each questionnaire required six 80-column punch cards to accomodate the data. This information was first transferred from punch cards to computer tape and the six cards for each case consolidated into a single record for a person (eliminating the duplication of identification items required on each punch card).

Each of the 45 occupations received a differential weight. The methodology involved in this weighting called for a consideration of the three following classes of responses:

1. Initial responses;

2. Responses from a field follow-up programme;

3. Responses from a file of "postal rejects".

The latter two classes had to be weighted to the totals from which they are drawn (1). The determination of these weights was done

(1) The methodology outlined herein was subject to review for the reliability of the follow-up data by Bureau sampling experts.

clerically and incorporated in the punch card. After these intermediate weights were on the record and applied to the latter two classes, this file was merged with the initial responses (class 1). The final weights to be applied to each occupation group were the proportions these merged totals bear to their respective grand total as determined by the 1960 Census results.

III. Publication and analysis of results

During the period of data collection and processing, the National Opinion Research Center with the support and advice of the sponsoring agencies designed tabulation plans. These plans were developed to produce as a minimum most of the priority items included in the questionnaires and to meet the operational needs of the agencies. Copies of the machine printouts produced by the Bureau of the Census were provided to the National Science Foundation, the other sponsoring agencies and the National Opinion Research Center. Table 3 shows a list of these basic printouts provided.

The Foundation then contracted with the NORC to produce reports from these tabulations on three broad areas: the employment of the 1960 scientists and engineers in 1960 and 1962, the education and training of the 1960 scientists and engineers, and characteristics of the college-educated population. The National Opinion Research Center has published two of these reports as: "The Education and Training of America's Scientists and Engineers: 1962" (Report N° 104) and "The United States College Educated Population: 1960" (Report N° 102). A third report "Employment of America's Scientists and Engineers, 1960 and 1962" is being published by the National Science Foundation. All three of these reports were based on selected tabulations covering five occupational groups: engineers, physical scientists, mathematicians, life scientists and social scientists. In addition, some of the sponsoring agencies have made direct use of the data from the survey. For example, the Bureau of Labour Statistics in a forthcoming report "Technician Manpower: Requirements, Resources, and Training Needs" used a substantial amount of information on the technician occupations. Also, many individual researchers have made use of the tabulations on hand at the National Science Foundation in a variety of studies.

The National Science Foundation in 1965 was provided a copy of the basic computer record tape for the postcensal survey by the Bureau of the Census. NSF has also contracted with the National Opinion Research Center to produce two additional reports based on the postcensal data. Using the basic record tape, NORC is to prepare one report on classifications of scientific and technical manpower and one involving a special detailed analysis of engineers. These reports should be completed by the end of 1966. The primary tabulations produced by the Bureau of the Census and on hand at the National Science Foundation will continue to serve as a source of information for researchers. In addition, the new tabulations provided by the National Opinion Research Center and the basic record tape will also be kept for future possible uses.

IV. Current and potential uses of the postcensal data

As described above, the original primary purpose of conducting the postcensal survey of professional and technical manpower was to "determine relationships between training and subsequent occupations". This primary aim has been largely served through the provision of information which has made possible the study of these relationships. In more specific ways some of these relationships and the issues they highlight can be stated.

Some of the more apparent uses of this information include: a detailed description of the formal education and training of persons in various professional, scientific, and technical occupations; an analysis of current occupation and field of work specialisation as well as overall job histories in relation to major fields of study at both undergraduate and graduate levels; the extent to which persons with less than a college degree are employed in professional occupations, and what types of informal training as well as experience may have contributed to their attaining such positions; an analysis of the personal and other background characteristics of the respondents to determine whether any insight can be obtained regarding differences in levels of training and subject matter studies. Information provided can aid in identifying clusters of values which charactsrize specific occupations or groups of occupations. In addition, it is possible to obtain clues regarding continuity of employment and future turnover among persons in various occupations, and in relation to such factors as age, geographic location, and training background.

What insights are provided by such data? The period 1960-1962 was marked, among other things, by an increase in vast Federal Government expenditures for research and development, a build-up of activities in both government and industry for the space programme, an increase in existing as well as new programmes for medical and health research, an increased emphasis on the development of new products in many science-oriented industries, and an expansion of college and university facilities to accomodats the influx of new students and provide for expanding research programmes. Against this background, the recent mobility data will provide an evaluation of the movement between employers, jobs, activities, and fields of specializations. For example, are more scientists moving from academic employers to industrial jobs than vice versa? Is a greater proportion of engineers concerned with administrative or supervisory duties than heretofore? Are certain industries attracting a higher proportion of the mobile personnel? Does there appear to be a shifting or upgrading of persons in non-professional jobs (the technician occupations) to professional occupations?

By going back to the age 24 starting point for job histories, it is possible to establish typical and variant career histories for specific occupations and occupational groups, for respondents with specific levels and types of training, and for those with certain demographic characteristics. Several additional general questions on employment which were included provide some further insights into the overall work history patterns: respondents were asked to indicate all the different types of employers worked for; the number of different employers for the current field of work specialization as well as the total number of years worked in the present field of specialization; and finally, some data on the different

fields of work specialization in which the respondent was engaged during his career other than those already indicated for the specific points in time requested.

The data on the college educated population are available for still other uses. Not only does the data provided by the persons in this group result in a comparative analysis of the Nation's college-educated population, but in terms of NSF's particular interests, it is possible to determine in large measure the extent to which persons trained in scientific and technical fields were working in occupations seemingly unrelated to this training; the same for persons who started their careers in professional, scientific, and technical occupations and were employed elsewhere; and finally, what potential exists among those in the professional and technical labour reserve for possible reemployment in professional, scientific, and technical fields.

It is hoped that the programme of postcensal studies outlined here will provide many insights helpful in contending with manpower problems affecting all sectors of the economy and the national welfare. The data and information culled from these studies and added to information from other past, current, and future studies will hopefully bring us closer to the day when the formulation of policies affecting our highly trained manpower will be undertaken with much greater assurance and confidence than heretofore.

Table 1

Detailed components of the universe and receipts in the postcensal study of professional and technical manpower

Occupations and other groups sampled	Number of cases in survey	Cases returned	
		Number	Percent
I. Occupations in the survey and their Census codes.	71,300	51,505[1]	72.2[1]
A. Selected professional occupations.	56,137	40,768	72.6
021 Chemists.	2,500	1,839	73.6
College presidents, deans and professors and instructors, nonscientific subjects	1,260	905	71.8
030 College presidents and deans			
054 Professors and instructors, nonscientific subjecte			
Professors and instructors, natural science.	2,501	1,856	74.2
031 Professors and instructors, agricultural sciences			
032 Professors and instructors, biological sciences			
034 Professors and instructors, chemistry			
041 Professors and instructors, geology and geophysics			
042 Professors and instructors, mathematics			
043 Professors and instructors, medical sciences			
045 Professors and instructors, physics			
052 Professors and instructors, natural sciences, not elsewhere classified			

(1) Figures include 966 cases received after the tally by occupation, thus detail will not add to total

Table 1 (cont.1)

Occupations and other groups sampled	Number of cases in survey	Cases returned	
		Number	Percent
Professors and instructors, social science	1,494	1,155	77.3
035 Professors and instructors, economics			
050 Professors and instructors, psychology			
051 Professors and instructors, statistics			
053 Professors and instructors, social sciences, not elsewhere classified			
040 Professors and instructors, engineering	2,000	1,529	76.5
060 Professors and instructors, subject not specified	1,249	873	69.9
080 Engineers, aeronautical	1,999	1,383	69.2
081 Engineers, chemical	1,270	974	76.7
082 Engineers, civil	1,948	1,354	69.5
083 Engineers, electrical	3,499	2,533	72.4
084 Engineers, industrial	2,000	1,457	72.9
085 Engineers, mechanical	1,999	1,399	70.0
090 Engineers, metallurgical and metallurgists	1,000	726	72.6
091 Engineers, mining	1,000	708	70.8
092 Engineers, sales	1,000	682	68.2
093 Engineers, not elsewhere classified	2,782	1,971	70.8
103 Foresters and conservationists with 4 or more years of college	1,000	820	82.0
111 Librarians - elementary and secondary schools; 111 Librarians - public libraries } with 4 or more years of college	1,751	1,335	76.2
130 Agricultural scientists	1,991	1,494	75.0
131 Biological scientists	3,502	2,528	72.2
134 Geologists and geophysicists	2,000	1,351	67.6
135 Mathematicians	1,909	1,321	69.2

Table 1 (cont.2)

Occupations and other groups sampled	Number of cases in survey	Cases returned	
		Number	Percent
140 Physicists	2,295	1,714	74.7
145 Miscellaneous natural scientists	1,022	787	77.0
172 Economists	1,136	805	70.9
173 Psychologists	2,150	1,570	73.0
174 Statisticians and actuaries	1,000	716	71.6
175 Miscellaneous social scientists	878	613	69.8
182 Teachers, elementary schools (Public schools only)	2,999	2,164	72.2
183 Teachers, secondary schools	3,003	2,206	73.5
B. Selected technical occupations	7,999	5,108	63.9
072 Designers	1,000	673	67.3
074 Draftsmen	1,000	701	70.1
181 Surveyors	1,000	587	58.7
185 Technicians, medical and dental	1,000	619	61.9
190 Technicians, electrical and electronic	999	636	63.6
191 Technicians, other engineering and physical sciences	2,000	1,274	63.7
192 Technicians, not elsewhere classified	1,000	618	61.8
II. Persons with an educational attainment of four or more years of college			
A. In experienced civilian labour force and not in the selected professional or technical occupations	2,948	1,903	64.6

Table 1 (cont.3)

Occupations and other groups sampled	Number of cases in survey	Cases returned	
		Number	Percent
1. Managers, officials and proprietors (not elsewhere classified) who were working in the following industries.	943		
- Agriculture, forestry and fisheries			
- Mining			
- Construction			
- Manufacturing			
- Transportation, communications, and other public utilities		1,903	64.6
- Professional and related services			
- Public administration			
2. Balance - Females, ages 20 to 54 years			
3. All others	2,005		
B. Labour reserve	3,313	2,160	65.2
1. Females, ages 20 to 54 years, with experience in one of the selected professional or technical occupations.	2,000		
2. Other persons with experience in one of the selected professional or technical occupations	267	1,681	74.2
3. All persons in the labour reserve with experience in occupations not selected for the survey.	1,046	479	45.8
C. Persons 20 years old or older not in the labour force, labour reserve nor institutions	903	600	66.4

Table 2

Sample selection for the postcensal study of professional and technical manpower

Occupation or classification	Original number of sample cases required (1)	Final number of sample cases required (2)	Original liberal sampling fraction (3)	Original sample count (4)	Sub-sampling ratio (5)	Final sample selected (6)
Total in survey.	73,000	76,869	-	152,510	-	71,300
Total professional occupations	55,000	59,869	-	90,774	-	56,137
Total college presidents, deans and professors	7,000	8,500	-	11,230	-	8,504
College presidents, deans and professors and instructors, nonscientific subjects. .	1,000	1,250	1/4	2,465	0.50710	1,260
Professors and instructors, natural science	2,000	2,500	1/4	2,548	0.98117	2,501
Professors and instructors, social science	1,000	1,500	1/4	2,167	0.69221	1,494
Professors and instructors, engineering	2,000	2,000	1/1	2,359	0.84782	2,000
Professors and instructors, subject not specified	1,000	1,250	1/8	1,691	0.73921	1,249
Total engineers.	18,000	20,282	-	32,654	-	18,497
Engineers, aeronautical	1,500	2,000	1/4	3,284	0.60902	1,999
Engineers, chemical	2,000	2,000	1/8	1,270	1.0	1,270
Engineers, civil	2,500	2,500	1/20	1,948	1.0	1,948
Engineers, electrical	2,500	3,500	1/10	4,618	0.75791	3,499
Engineers, industrial	2,000	2,000	1/8	3,095	0.64621	2,000

Table 2 (cont.1)

Occupation or classification	Original number of sample cases required (1)	Final number of sample cases required (2)	Original liberal sampling fraction (3)	Original sample count (4)	Sub-sampling ratio (5)	Final sample selected (6)
Engineers, mechanical.	2,500	2,500	1/20	1,999	1.0	1,999
Engineers, metallurgical and metallurgist	1,000	1,000	1/2	2,305	0.43384	1,000
Engineers, mining.	1,000	1,000	1/2	1,526	0.65531	1,000
Engineers, sales	1,000	1,000	1/2	7,170	0.13948	1,000
Engineers, not elsewhere classified. . .	2,000	2,782	1/4	5,438	0.51159	2,782
Foresters and conservationists (4 years of college).	1,000	1,000	1/1	2,936	0.34060	1,000
Librarians	2,000	2,000	1/4	5,250	4 years college	1,751
Total natural scientists.	16,000	16,800	-	19,237	-	15,219
Agricultural scientists	2,000	2,000	1/1	1,991	1.0	1,991
Biological scientists	4,000	4,000	1/1	3,502	1.0	3,502
Chemists	2,000	2,500	1/8	2,617	0.95530	2,500
Geologists and geophysicists	2,000	2,000	1/1	4,695	0.42599	2,000
Mathematicians	2,000	2,000	1/1	1,909	1.0	1,909
Physicists	2,000	2,300	1/1	3,501	0.65696	2,295
Miscellaneous natural scientists	2,000	2,000	1/1	1,022	1.0	1,022
Total social scientists	5,000	5,287	-	10,080	-	5,164
Economists	1,000	1,137	1/1	4,814	0.23619	1,136
Psychologists	2,000	2,150	1/1	3,014	0.71334	2,150
Statisticians and actuaries	1,000	1,000	1/4	1,373	0.72834	1,000
Miscellaneous social scientists	1,000	1,000	1/1	879	1.0	878

Table 2 (cont.2)

Occupation or classification	Original number of sample cases required (1)	Final number of sample cases required (2)	Original liberal sampling fraction (3)	Original sample count (4)	Sub-sampling ratio (5)	Final sample selected (6)
Teachers, elementary public schools. . .	3,000	3,000	1/50	4,197	0.71480	2,999
Teachers, secondary schools	3,000	3,000	1/25	5,190	0.57804	3,003
Total technicians	7,000	8,000	-	32,934	-	7,999
Designers	1,000	1,000	1/10	1,672	0.59809	1,000
Draftsmen	1,000	1,000	1/50	1,061	0.94251	1,000
Surveyors.	1,000	1,000	1/5	2,291	0.43650	1,000
Technicians, medical and dental	1,000	1,000	1/20	1,734	0.57671	1,000
Technicians, electrical and electronic .	1,000	1,000	1/1	23,176	0.04315	999
Technicians, other engineering and physical science	1,000	[illegible]	[illegible]	[illegible]	0.42699	2,000
Technicians, not elsewhere classified .	1,000	1,000	1/5	[illegible]	0.29941	1,000
Persons in "Other" groups with 4 years of college	11,000	9,000	-	23,778	-	7,164
Total experienced civilian labour force not in target occupations	3,000	3,000	-	[illegible]	-	2,948
Selected managers	1,000	1,000	1/100	943	1.0	943
Balance females ages 20 to 54	1,000	1,000	1/20	8,207	0.10309	2,005
All others	1,000	1,000	1/100	7,373	0.13211	

Table 2 (cont.3)

Occupation or classification	Original number of sample cases required (1)	Final number of sample cases required (2)	Original liberal sampling fraction (3)	Original sample count (4)	Sub-sampling ratio (5)	Final sample selected (6)
Total labour reserve	5,000	4,000	-	6,353	-	3,313
Females ages 20 to 54 in target occupations.	4,000	2,000	1/25	2,950	0.67797	2,000
All others in target occupations	1,000	1,000	1/100	267	1.0	267
Not in target occupations	-	1,000	-	3,136	0.33333	1,046
Persons 20 years old or over not in the labour force, labour reserve nor institutions	2,000	2,000	1/200	903	1.0	903

Table 3

Primary tabulations of postcensal survey of professional and technical manpower (1)

I. 1960 occupational characteristics

Variables

Occupation:

by sex and age
by sex and highest degree
by age and highest degree

Subject of tabulation

Industry group
Type of employing organisation
Class of worker
Field of work specialization
Change in organisation, occupation and field of work specialization between 1960 and 1962
Years with present organisation
The two most time-consuming job activities performed
Occupation at age 24, or first job thereafter
Fields of work specialization ever worked in
Types of employing organisations ever worked in at least 6 monts
Years of education
Types of elementary and high schools attended
Curriculum of senior year in high school
Size of high school graduating class
Field of study for highest degree
Field of study for each degree held
Year work ended on highest degree

II. 1962 Occupational characteristics

Variables

Occupation, 1960, by occupation same, 1962/occupation different, 1962:

by sex by age, 1962
by sex by highest degree, 1962
by age by highest degree, 1962

(1) A copy of these tabulations (in the form of machine printouts) is filed at the National Science Foundation and is available there to researchers.

Subject of tabulation

Employment status
Industry group
Type of employing organisation
Class of worker
Salary
Occupation
Field of work specialization
Hours worked weekly
Years with present organisation
Earnings in 1961 from major job
Sources of secondary income
Total earnings in 1961
Job activities performed
First two most time-consuming job activities performed
Years in present field
Years of education
Field of study for highest degree
Field of study for each degree
Year work ended on highest degree
Sources of financial support for graduate training
Sources of financial support for undergraduate training
Single most important source of financial support for undergraduate training
Single most important source of financial support for graduate training
Types of experience and training contributing to qualifications for present job
Supplementary training (Yes - No)
Subject of supplementary training
Citizenship
Region of residence
Father's occupation (when respondent was 16)
Marital status

III. College educated population as of 1960

Variables (1960)

Field of study for highest degree:

- by sex by age
- by sex by highest degree
- by age by highest degree
- by age by labour force status
- by highest degree by labour force status

Subject of tabulation

Employment status, 1962
Employment status, 1960
Industry group, 1960
Type of employing organisation, 1960
Class of worker, 1960
Occupation, 1960
Field of work specialization, 1960
Field of work specialization, 1962
Salary, 1962
Earnings in 1961 from major job
Types of employing organisations ever worked in at least 6 months
Types of elementary and high schools attended
Curriculum of senior year in high school
Size of high school graduating class
Field of study for each degree
Field of study beyond highest degree
Year work on highest degree ended
Citizenship
Region of residence
Father's occupation (when respondent was 16)
Number of dependants
Marital status
Number of children
Membership in professional societies
Professional articles or books published or papers read at professional meetings.

B. TOWARDS A BETTER UTILISATION OF SCIENTIFIC AND TECHNICAL PERSONNEL

A SOCIAL RESEARCH APPROACH TO THE EDUCATION AND UTILISATION OF ENGINEERS

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The Education and Utilisation of Highly Qualified Personnel

I. Introduction

Discussion both in this section and those which follow considers the following subjects:

(a) A criticism of the traditional labour market approach;

(b) Selection and screening processes and the aspirations of secondary school students;

(c) Higher education as a social system;

(d) The career patterns of engineers;

(e) Educational policies of the Norwegian Society of Engineers;

(f) The importance of personality factors in institutions;

(g) Value conflicts in engineering jobs.

The traditional labour market approach (as briefly outlined in section B of this paper) seems inadequate for the efficient handling of the problems of the education and utilisation of highly educated personnel. Analysis of previous research in this field shows that organisational and institutional factors are operating in such a way that the labour market mechanisms can, at best, create only a long range balance between the supply and demand of highly educated personnel. A considerable imbalance is likely to appear in short and medium range adjustments. The negative effects of this imbalance may be quite serious on both the aggregate and personal levels, in companies and in professional circles. The labour market model may, in fact, be rather irrelevant if we compare actual situations in education and industry with the ideal conditions under which labour market mechanisms are theoretically assumed to function.

Ideally one would assume that pupils in high school would be motivated to invest time in such school subjects and to seek such vocational information as are relevant to their abilities and aptitudes for future careers. Initial studies undertaken by our institute (summarized in section II of this paper) indicate that the selection and screening processes in high schools may be the dominant aspect of actual teaching-learning situations. School work may therefore be primarily oriented towards short-term goals, e.g. avoiding failure in terms of grades and examinations. If the selection for higher studies is based on grades in high school, as it is in Norway, then we find that pupils tend to postpone the search for information about careers and higher education until their final school results are known. The pressure for good school grades at an early age is, of course, not confined to Norway, and leads to unexpected consequences in the education and utilisation of manpower in other countries as well.

Within educational institutions where technologists are trained we find that existing selection systems, social norms and values cultivated by students and staff do not effectively structure career preparation and the transition from university to professional life. Nor, we submit, is there a positive structuring by the actual teaching programmes of the school or by the practices within companies for hiring and promoting professional engineers. When Norwegian technologists are productive in traditional engineering jobs as well as managerial positions, this may be explained partly by the high calibre of recruits that are drawn to engineering, - partly by the basic training they get in school and university and partly by the supplementary education which is now actively promoted by firms and by the Society of Engineers.

We have found a number of indications that there are considerable shortcomings in the operating of:

(a) Educational institutions;

(b) Industrial organisations;

(c) Professional societies.

By recognizing the different time sequences and the complexity of the adjustment mechanisms within and among these three kinds of organisations we can see why the traditional committee approach will not achieve adequate change in a period of rapid technological and social flux. If for instance industrial demands create needs for educational changes it will usually take a few years before an educational committee or commission

is set up to consider reforms. The formulation and implementation of changes will not usually appear until several more years have passed. And decades may pass before changes in education are reflected at job level or in the career patterns of professional people.

Short-range and medium-range adjustments can be created at different levels; between the highly educated person and his job, between the company organisation and the educational institutions and between professional societies and the career aspirations of professional people. However, to establish useful adjustment mechanisms on all these levels is possible only if we explore the facts of social life as we find them through research in schools, in business organisations and among professional people. However irrational existing social processes seem to be from a labour market point of view, they are still the bases for future social policy and action.

It is also important to be aware of the fact that new trends may be emerging in industrialised society in the way people perceive their own work situation and their profession. Education and work are not only means to an end but represent also basic values in human life. Problems of alienation limit personal satisfaction and the lack of motivation experienced in the daily work situations among people at different levels of industrial organisations have created in the Scandinavian countries a growing interest in a new approach to industrial democracy. Welfare programmes, joint consultation and formal systems of co-determination seem to have had a limited effect on the levels of satisfaction, the release of initiative and personal growth in the daily work situation so long as we continue to have a mechanistic approach to the organisation of work. Since 1963, the Trade Unions, the Employers' Association and Government have jointly sponsored a research programme in Norway with actual field experiments in industrial firms to determine how to improve conditions for personal participation and the efficient application of human resources in industry. Some aspects of this research work are outlined in section III of this paper and may offer some new ideas about the education and utilisation of manpower in general.

The scientific knowledge of social processes operating within educational systems and within industry is rapidly increasing, but the complexity of this whole general problem area should not be under-estimated, particularly when cross-cultural co-operation is concerned. For the purpose of illustration this may be more clearly understood if we explore some initial studies in the field undertaken during the past few years in Norway. We shall also (in section III) outline some practical steps to be taken and some further research needed to achieve better conditions for the release of human resources in the education and utilisation of highly qualified personnel.

II. Review of previous work and different approaches

The traditional labour market approach

The traditional labour market approach to problems of education and utilisation of personnel is based on the assumption that two major sets of factors are involved: the first consists of the requirements of the work

situation. The second set consists of the skill, knowledge and other human resources brought into the work situation by a person. Under this approach to achieve optimal education and utilisation of personnel one should:

(a) study the work requirements;

(b) construct the jobs; and

(c) set up corresponding educational facilities to ensure that a sufficient number of qualified personnel are channelled into the labour market;

(d) analyse the available applicants for jobs in terms of personal characteristics;

(e) put "the right man in the right place".

This "peg and hole" approach may be realistic and useful when a society is facing a major and rapid re-allocation of its labour force such as in a war situation or in a period of widespread unemployment. And in the long run economic and social forces tend to be correlated with trends in education, in professional careers and in deployment of personnel. But in the short run the picture is different.

The personnel specialist of an industrial company in the 1960's who deals with the actual problems of recruitment, deployment and utilisation of personnel has one major reaction to the traditional systematic labour market approach: "It never works this way". It may work to some extent for unskilled manual labour or in a military organisation but it certainly does not apply to highly educated manpower in modern industrial organisations where the deployment and utilisation is related to complex forces. The analysis of task requirements and the design of jobs are scarcely finished before tasks are changed to suit market demands or technical development. The educational system, labour contracts, rules of the trade or professional demands are structuring the allocation of men to work. Over long periods of time this structure has been rather stable, but this seems no longer true in most industrialised countries. Vast changes are taking place with such speed that the deployment and utilisation of personnel become an art of continuous improvisation rather than a mere matching of work requirements and personal characteristics.

Improvisation rather than systematic problem-solving is necessary partly because we know so little about the problems of education and deployment of personnel in modern work organisations. We are also forced to rely on improvising because whatever is known about these problems tends to be converted into action too late to be of any practical importance, as the problems have already changed in character. Herbst points out to be efficient in the 1960's that corrective steps would have had to be taken in the late 40's. Whatever action we take in the late 60's insofar as the educational system is concerned, the practical impact will not be effective before the late 70's.

As part of this OECD project we have summarized herein some exploratory studies conducted by our institute. Some educational and organisational problems have been studied and the results may be relevant to and considered for future work on the deployment and utilisation of highly educated personnel. After a brief summary of the relevant aspects of these studies it may be possible to outline a somewhat new approach and to plan the research that must be done.

A study of pupils' time investment in different school activities

Philip G. Herbst has recently made a study of person-task relations in the school situation. A by-product of this study is that it throws some light on the teaching-learning situation as perhaps experienced by people of 16-17 years of age.

Ideally, one would assume that this teaching-learning situation would be geared to the optimum cultivation of ability and interests among young people and to assist in the choice of further education and ultimate career. However, there are strong indications that the dominant characteristics of the teaching-learning situation are part of a control and selection process rather than a learning and development process. The major amount of work that pupils put in is geared to short-term means rather than long-term aims. Their studies are channelled into activities and subjects which are most important as safeguards against failure in the screening process. One finds there is a relatively little time investment in the positive seeking and striving for deeper understanding of intellectual problems. This would not be so bad for the pupil if one could be fairly sure that the screening process is a healthy one for the young person and for higher education and professional training. However, there is good reason to believe that the screening procedure is more relevant to other purposes, namely to maintain discipline in the classroom and to enable schools with limited capacity to channel the stream of young people through the educational system without causing undue disturbance to the system itself.

If we consider the screening procedure of our school system we are in fact faced with some very tricky problems. What degree of differentiation is desirable at what age levels according to the development of personality and temperament of young people? Paasche has in a recent survey of relevant research pointed to some problems facing young boys and girls in the United Kingdom who have a strong inclination at the age of 14-16 to begin technical studies. How can this inclination be nourished when there is little in the school system relevant to the gifted and technologically oriented 15-20 year old student? This becomes even more difficult when engineering as a profession is of relatively low social esteem in the United Kingdom when compared to the United States of America and the Scandinavian countries. No wonder that 900 places were left unfilled in United Kingdom colleges of technology in 1964.

A pilot study of high-school pupils' orientation to higher education

Utvik has recently made a pilot study on a small sample of students at the age of 19 before and after matriculation examination in Oslo. For the sake of further illustrations we may extract some questions related to the screening and education process among young people interested in studies of technology.

Ideally, one would assume that the screening process between school and higher education would be part of an institutionalised transitional phase in the life of young people. Such a transitional phase depends, among other things, on knowledge of the manifest and, if possible, the potential abilities and interests among students. Information on the opportunities and requirements of higher education and those of vocational life should also be part of such an institutionalised transition. It is indeed

difficult to match educational activity to vocational requirements and equally difficult to have the values of vocational or professional life well-represented in the system of general education. One way of avoiding these difficulties is to leave the value choices involved in the transitional process to the individual young student. Some ethical problems are also being avoided by leaving the choice to the student himself. But this means that alternatives must be presented to the individual in such a way that he can also judge at least the major consequences of entering one line of higher education to the exclusion of others. Even if we take for granted that alternative choices are not enforced too early in young people's lives one major difficulty remains. How is it possible to present information in such a way that choice of education and career is made as realistic as possible?

In Utvik's study we find strong indications that relevant information is not sought to any great extent until just before matriculation examinations. Since this examination in Norway decides whether a pupil enters engineering, for example, he often seems to put aside the problems of choice until his examination results have appeared. This is not true for all students. Those who have close relatives in the engineering profession seem to have a more clear idea about the choice and have often thought of alternative ways of education and career. Thus it is obviously not enough to offer information about careers and higher education as is at present done in the Norwegian school system. It seems important now to consider the school system itself and its effect upon the long-term process of choosing and being trained for a career. In Norway this process is greatly influenced by the fact that the selection for a number of courses of higher studies is based exclusively on grades in high school. This may be one of the reasons for the concentration of effort among pupils in high school on those subjects which are part of the screening process. Obviously, with limited resources, some sort of selection must take place but the point is that selection can take place gradually and preferably at such age levels that both the pupil and the school have the best possible chance of making a good choice in terms of later success.

This particular point about the screening system in the Norwegian schools may not be considered important in other countries with alternative selection systems. The important point to be made, however, is that there is always a certain relationship between the selection system, the educational system and the wider problems of utilisation of human resources.

A study of the selection procedure to the Norwegian Institute of Technology

A study by Erna Walle has shown that matriculation examination (at the age of 19) correlates positively ($r = 0.20-0.35$ for different departments) with final grades in the school of technology. However, grades during the first and second year in the school of technology have a higher correlation. For basic science subjects the correlation (r) is usually between 0.60 and 0.70. These science subjects are not unique for studies of engineering. Consequently, much can be said for postponing at least part of the selection procedure to the second year of the school of technology, rather than basing the selection on matriculation examination. This would influence the first part of the study in the school of technology and would raise some

practical problems, but would also have its advantages for the school as such. As we shall point out later, it may also be an important part of the integration of some basic processes involved in the deployment and utilisation of highly educated personnel.

Studies of a school of technology as a social system

During the late 50's and early 60's several studies were made of the Norwegian School of Technology in Trondheim. The effect of the school's growth on the teaching-learning situation was investigated by studying the time allocation among students on different study activities and the norms and values predominant among student and staff. A few results are relevant within the context of this paper. These findings show that the students in the entire 4 1/2 years of study spent most of their working time (45-80 per cent of a total of 45-50 hours a week), during the normal term, in laboratory and draftroom exercise. Lectures absorb the major part of the remaining time, while individual reading and study took little time except when examinations were near and all other activities curtailed. During the first year of study, mathematics and other basic subjects are combined with great difficulty with more practical exercises which give a more rapid knowledge of results in line with the student culture. The practical exercises coincide with the need among students for orientation about the characteristics of engineering as a field of study and as a career pattern. But such orientation should not take too much time during a phase of education when basic subjects must have first priority.

There is plenty of room for constructive innovation in order to bring the actual study performance in a school of technology closer to the ideals established in the official plan of study. This plan intends primarily to emphasize basic science subjects during the first two years but to include some practical exercise as part of the basic training to orient students towards engineering as a profession.

The values among students and staff showed a potential conflict between academic-theoretical values on the one side and professional-engineering values on the other. Social and administrative values are fairly dominant in industry, where the students are going to work, but have little room in the study programme.

From the point of view of utilisation and deployment of highly educated personnel there is little in most sub-programmes of this school which assists the gradual introduction of the students into engineering as a profession. In the future there may be even less emphasis when basic science subjects play a larger role, especially in the first 2-3 years of study. This poses a basic problem for engineering education.

Industrial apprenticeship is a prerequisite for entering the Norwegian School of Technology and could easily be adjusted to offer more insight into engineering as a field of study and as a profession. During the latter part of formal study some voluntary choice of subjects is left to the students and these subjects could be linked to the actual problems of engineering to be faced by the young graduate entering industry. This introduction to engineering cannot be guided equally well by all professors. Some problems of recruitment and promotion of university teachers as well as other organisational problems of the academic institution must be solved

for an integrated approach to the training and utilisation of highly educated personnel in industry. Further discussion of these problems will be considered in the concluding chapter of this paper.

A study of the positions and the career pattern of engineers

In 1959-61 P.A. Holter conducted a study of engineers and technicians in Norwegian industry with particular reference to their educational background and career development. Some statistical evidence was analysed. The distribution of university-educated engineers between State and municipal services and private industry (22 per cent, 11 per cent and 67 per cent respectively) is mainly of national interest as is the distribution between branches. Of more general interest is a movement, as engineers grow older, from larger to smaller firms, from State and municipal services to private industry and from scientific and purely technical work to administrative activities.

Of the norwegian engineers educated in the period 1945-56, 13 per cent in 1957 were employed in research and development, 30 per cent in purely technical work, 43 per cent in combined technical and administrative posts, and 13 per cent in technical-business activities. A new survey would be needed to observe a current trend towards a growing number of engineers in research and sales activities. However, any ilar research of a statistical character will be of little general intere until a better classification of engineering work has been found. This was the very reason why Holter directed the major part of his research towards an exploration of the job content in engineering at company level.

Holter made case studies of what happens when companies advertise for engineers and jobs are filled. How are jobs described? Are the jobs part of a systematic structure of positions in the firm? Will such jobs be appreciated by engineers as part of a career pattern? Are the jobs defined by required educational background and the needs for supplementary or complementary job training? Considering the present practices in the companies studied what are the potential and manifest role conflicts among engineers? How can these conflicts be understood in terms of a growing professionalisation which is supposed to be taking place among engineers?

Holter's results are only tentative and mostly negative. He did not find the clear conceptions of engineering jobs that one would expect for the formulation of company policy on recruitment, deployment and utilisation of engineers. He did not find any clear conception of different kinds of engineering jobs as part of a well-defined career pattern. He did find that company organisation and personnel policy may often put the engineer in a conflict situation where he has to choose between limited promotion opportunities in what is perceived as a professional engineering job or getting better promotion in a field of work for which he is not educated.

Holter points to a number of reasons why engineering as a profession has so far been loosely defined in Norway and has therefore represented a flexible and valuable pool of highly educated personnel. He also points to some future difficulties unless the educational policies in schools of technology and the organisational policies in industrial companies are not gradually co-ordinated in view of changes in the engineering profession. We shall return to these questions raised by Holter in the concluding chapter of this paper.

Educational policy of the Society of Engineers

We have worked for some years in close contact with the training activities of the Norwegian Society of Engineers and were impressed by the impact of some important decisions in terms of professional policy within that society. One of the decisions was a considerable investment in training activities in general and in administrative training in particular. A corresponding development has appeared in the other Scandinavian countries where engineers have similar training and status. Another professional policy decision resulted in pressure exercised upon educational institutions to give more room for social science subjects to be taught to technologists. A third change in policy was considerable pressure at company level to increase job training, particularly for young engineers.

During a strong national drive to educate more engineers (250 per cent increase from 1950 to 1965) the society firmly backed this educational policy. This even led to considerable opposition from young engineers who felt they were not being employed according to their educational level. Concurrently there has been active interest in the Society of Engineers for research to clarify job requirements among engineers in industry.

All the policy questions mentioned have been explicitly discussed at annual meetings of the Engineering Society and at a special conference on the education of engineers. During the latter session there were representatives of three major groups, the Society of Engineers, the educational institutions and the larger companies who, in fact, employ the majority of Norwegian engineers (75 per cent of all engineers in Norway are employed by companies with more than 50 staff people each). Some of the policy questions mentioned are clearly related to professional problems experienced by practising engineers. We also feel that the three above-mentioned groups are the vehicles through which a change in engineering as a profession will have to be introduced. This is important to bear in mind when practical reforms are considered regarding the deployment and utilisation of technologists in industry.

The importance of personality factors restated in institutional terms

So far, this paper has mainly dealt with educational, organisational and professional factors which influence the development of engineers. However, it is often stated that engineers are what they are mainly because of their personality. This can also be said of doctors, and lawyers, military officers and priests, but perhaps less so than for engineers. Those in the former professions seem to be more bound by clear prescriptions about what to do and how to do it, what training is required for different kinds of jobs and what kind of career is open after professional training. These are certainly less well defined for engineers, so that personality factors may be much more important in the selection, training and deployment of engineers.

Extensive research has shown that the use of personality tests in the academic selection procedure has produced only meagre results. On the basis of a survey of relevant research, Joshua Fishman has suggested that greater emphasis should be put on the social psychological factors in student work situations than on selection techniques. This is in line with the findings of studies made of the Norwegian Institute of Technology.

The values and norms represented in the teaching-learning situation and the values and norms dominant in the student culture seem to be as important as motivation factors. Paasche's survey of relevant research indicates that the basic-value orientation among young people interested in technology is fairly stable from the age of 14-15 provided that opportunities for education and work exist so that these values can be pursued and cultivated. Therefore, the importance of personality factors in the work behaviour of engineers can perhaps be reformulated in institutional and organisational terms.

The educational institutions will do their jobs by channelling young students into different professional categories. The labour market and the company organisation will manifest and apply the social forces which influence the growth of personalities. Intrinsic personality factors establish limits on what the individual engineer can be in terms of work behaviour but it is also equally true that the institutional context will decide what potential personality traits will emerge in the personal role behaviour of a professional engineer.

Trist, Emery and Herbst have emphasized that the socio-technical aspects of work are of primary importance in building an efficient work organisation where human resources can be released at an optimum level. Production requirements will, to a great extent, set the limits on work organisations as social systems. But the technical requirements of a work organisation cannot be fulfilled at an optimum level unless socio-psychological factors are accounted for in job design. Herzberg and his associates concluded that work content is a primary motivating factor while external work conditions are the primary cause of dissatisfaction. If this is right, then we may have an important basis for designing jobs for engineers that are stimulating and productive at the same time.

In a recent work paper, Stemerding has stressed the importance of meaningful transitional phases in the education and the career of engineers. It seems important to have such content and methods included toward the end of the formal school sequence so that pupils can examine their interests in subjects relevant to the practice of engineering. Similarly, at different phases of a school of technology, subjects might be so represented that these different phases can be experienced as meaningful steps towards a career in engineering. And in the company situation it must be recognized that the job content at different phases of a career in engineering must correspond and not conflict with values established in engineering education and values associated with engineering as a profession.

A case study of potential value conflicts in engineering jobs

The value conflicts experienced by engineers are often related to the administrative requirements included in engineering jobs. To check this hypothesis Lange has made a case study of engineers in a Norwegian company to see at what career stage these conflicts begin to appear clearly. He did not find that the conflicts appeared systematically after a quantifiable number of years after graduation. He did find that value conflicts were caused by a lack of correspondence between job content and personal value orientation. Furthermore, he found that external factors, housing for example, played a decisive role in the choice of jobs among engineers.

The value problems in engineering jobs could be solved in two days, either by excluding the administrative components from jobs or by including the administrative aspects of engineering in the education of engineers. The former solution seems impractical in most cases since few engineering jobs are exclusively technological in character. Products or services cannot be produced unless economic factors of raw materials and of processes and machinery are considered. This has led Boumester to suggest three different levels of engineering work, the first level primarily related to the product, the second to production and the third to productivity. The first level is primarily technological in character. The second level has technological and economic aspects. The third has technological, economic and social aspects. If we add research then we have four different levels of engineering cutting across economic branches. Appreciation of these levels can assist in the comprehension of both job design problems and value conflicts in jobs and careers of engineers.

Summing up prior research

In this review of previous work on the problems of deployment and utilisation of highly educated personnel we have given priority to studies made in Norway and related to engineers (Stemerding - has presented a wider survey of the literature). We have done this for two reasons. First, these studies are not yet known outside Norway because of the language difficulty. Secondly, in considering only one profession, one can more easily see the problems in a longitudinal perspective. One is forced to see the relation between basic education and professional education. One is forced to see the relations between professional education and professional practice in a company setting. Finally, one can more easily see the importance of the job and the career in the perspective of the professional society to which the highly educated person is relating himself in terms of values and job satisfaction.

Turning back to the beginning of this chapter we may now see why the traditional labour market approach is inadequate to treat the deployment and utilisation of highly educated personnel:

(i) The theoretical background for the existing principles of job classification and job design is, in general, too primitive to take account of the changing requirements forced upon work organisations by rapid technological and social change;

(ii) The theoretical background of existing principles of job design and career planning is particularly weak when social and psychological factors are concerned;

(iii) Educational institutions and professional societies are structuring the value systems of highly educated people. Human resources can be used at an optimum level only when the job content and career patterns in industry are in line with the value systems dominant in education and in professions. However, the changes in the value systems of schools, professions and work organisations are probably occurring along different time scales.

(iv) Preliminary analysis of the educational, professional and work organisational situations of highly educated personnel reveal that:

The characteristics of these three different kinds of situations are interrelated. Long-term adjustment mechanisms are operative;

Short-term adjustments can always be made at an individual level but within the total set of interrelated situations mentioned we find characteristics of short-term disfunctioning;

Medium-range adjustments could probably be arranged by institutionalising new kinds of feedback between the three kinds of situations. This would make it more likely that short-term adjustments at individual level could be made in the right direction. It would probably also reduce short-term disfunctioning within the total set of interrelated situations. (In a theoretical note on education of engineers Emery and Thorsrud - see References - have outlined a logical analysis of engineering education in terms of programmes).

In the next chapter we shall illustrate in concrete terms what changes can probably be made at different levels to achieve a better utilisation of highly educated personnel. We shall concentrate on some particular points which we hope to clarify further in research and development work currently under way at our Institute.

III. Adjustment mechanisms affecting the utilisation and deployment of highly educated personnel

Though we are convinced that the short-range and medium-range effects are limited, we shall assume that the labour market mechanisms are operating - that surpluses or shortages of different skills will influence wages and vice versa. We shall also take for granted that attempts are being made, along traditional lines, to predict future demands in quality and quantity of personnel needed and in planning and creating the necessary educational systems. Within the context of this paper we find it unnecessary to discuss how personal adjustment can be partly achieved by leaving the person free to move from one job to another when he finds a post that suits his own needs. At the individual level of change we stress the importance of leaving individuals free to participate in creating their own jobs. This seems particularly relevant when dealing with highly educated personnel whom, we assume, will have considerable insight into the content of their own jobs and are aware of their own personal capacities.

Case studies and field experiments in companies to improve job design and organisational conditions

In an extensive research project aiming at the improvement of conditions for personal participation in the work situation of all levels of personnel we have formulated some general psychological requirements important in job design, i.e. the need

(i) for the content of a job to be reasonably demanding in terms other than sheer endurance;

(ii) to learn on the job and to go on learning;

(iii) for an area of decision-making that the individual can call his own;

(iv) for social support and recognition in the workplace and in the trade or profession;

(v) to be able to relate what one does and what one produces to one's social life;

(vi) to feel that the job leads to some sort of desirable future.

These requirements were initially formulated on the basis of research among workers, but such requirements are not confined to one level of employment. Quite obviously it is not possible to meet such requirements in the same way in all work situations for all kinds of people.

These needs or requirements, however true, are too general to use as principles of job design. They need to be linked to objective characteristics of actual jobs. These needs cannot always be judged from conscious expressions among employees, and this further complicates matters. As in any set of psychological needs the above are subject to a wide range of vicissitudes. Thus, where there is little chance of learning a person will forget such requirements if he cannot move to a different job.

There seem to be two main approaches available to improve both job design and organisational conditions in line with the above-mentioned psychological needs; one is job enlargement, another is the development of relatively autonomous work groups. For highly educated personnel, job enlargement seems to be the obvious answer, but in many cases modern technology and current organisational practices lead to standardisation of jobs and reduction of autonomy even among highly educated personnel. At least this is our impression from companies where simulated models and computers are introduced in design, planning and control.

There are also other technological and organisational factors, particularly in large firms, which may contribute to narrow specialisation and tight control in jobs for highly educated personnel. Traditional job design takes for granted that maximum specialisation and standardisation of jobs lead to higher productivity though there is strong evidence to the contrary. Specialisation beyond a certain point tends to make jobs meaningless and leave people with a feeling that there is no room for initiative and personal involvement, that there is no challenge to learn, and no need to use one's own judgment. People in such jobs will find little motivation in their jobs. Close supervision or other kinds of external control may be necessary to enforce work standards and norms. A vicious circle can easily develop in such situations since close control tends further to decrease personal initiative and a sense of personal responsibility.

There is a strong basis for assuming that complex work organisations with advanced technology cannot function smoothly unless a high degree of self-regulation is built into operational units. There are three conditions for such self-regulation to take place:

(i) Top management must be able to interpret market demand and inventory company resources in order to formulate the concrete goals for which relevant criteria can be set for efficient achievement by operational units;

(ii) Personnel within the organisation must have the necessary education and skill to be able to fulfil their tasks within flexible operational units;

(iii) The personnel must be sufficiently committed to their work in order to be willing to use their knowledge and skill and to take responsibility in daily work situations.

Descriptive studies are now of great importance to show how efficiently work organisations are utilising their human resources. Such studies must indicate what kind of work is actually performed by people in daily work situations. But general job descriptions and job titles give very limited information. We have found that it is necessary to make a further breakdown and make task structure the basic point of departure for analysis of job requirements and utilisation of personnel. Stemerding has recently outlined some major categories that we are now trying out in actual field studies.

First, a differentiation must be made between:

(i) units, or physical objects with which work is concerned;

(ii) operations, or activities performed; and

(iii) communication-modi, or social settings where activities take place.

Secondly, differentiation must be made between:

(i) individual task structure;

(ii) internal organisation structure, and

(iii) relations between the company and its markets.

Thirdly, existing plans must be evaluated in time-perspective. These categories can be broken down in operational terms and comparative studies will be made of:

(i) careers or variation in task structure over time for engineers and technicians in the same company;

(ii) the task structure of one organisation as against that of other organisations.

Case studies along these lines will be followed by field experiments in companies regarding the re-allocation of tasks among highly educated personnel. Models for such experiments have been tried out at lower levels of organisation within Norwegian companies over the past two years and preliminary results are promising. Similar studies based on the socio-technical analysis of organisations and on field experiments are also going on in the United Kingdom, in Ireland and Holland under the direction of the Tavistock Institute of Human Relations in London. (Professor Louis E. Davis at the University of California, Berkeley, is involved in related

research). Wider international co-operation in this kind of research work will certainly be important in the next few years to improve the scientific basis for new policies to be worked out for the better utilisation of human resources at all levels in industrial organisations.

Representative surveys among professional groups on the actual deployment of highly educated personnel

As part of our present research work we are co-operating with Scandinavian societies of engineers in surveys and analyses of the actual deployment and utilisation of engineers. We are facing the same major problem as we have met before in survey work of this kind, namely the lack of a theoretically valid classification system. Recently, we have made some progress in this respect and have received active co-operation from individual engineers in approximately 20 Norwegian companies who are making detailed descriptions of engineering jobs. At the same time, contributions from members of the Tavistock Institute of Human Relations (Trist, Emery, Boumcester and Paasche) have helped to create a better basis for investigating the needs of engineers and scientists. The nationwide survey which is now being made among engineers in Norway is designed to cover major aspects of task structure and career patterns according to the categories mentioned for the case studies as described in the preceding chapter of this paper.

During the first half of 1966 we hope to present the first results of these surveys. It should now be possible to get representative data to see if earlier trends are persistent. We are thinking of the relative increase in the number of engineers entering research and development, marketing and administrative jobs.

In the context of this paper our main point is that representative surveys repeated at regular intervals can reveal structural changes in professional careers. Systematic feedback of survey results will have to be handled with great care in order to induce appropriate reactions from educational institutions, by companies and professional societies.

Further development work regarding supplementary education organised by professional societies and individual companies

As already indicated, some important policy changes are emerging from professional societies in terms of supplementary education for their members. During a conference in 1965 we received information from representatives of all the Scandinavian professional engineering societies that there were common trends in programmes of supplementary education. We find that the content of programmes indicates special needs in different branches for supplementary education in modern techniques which are not normally part of general education for technologists. Perhaps general education should meet some of these needs. This seems to be the case with certain social science subjects such as economics, organisational theory and techniques for the optimalisation of decision-making. In any case it does seem useful to analyse the educational gaps that professional societies are trying to remedy. Such needs are important indications of changes taking place in the companies and in the labour market and the

way in which the professional societies react is important for the future career patterns of engineers. And if we have a better knowledge of existing and emerging career patterns open to young graduates from professional schools, such knowledge can be spread systematically and may become an important part of continuous adjustment mechanisms to improve the utilisation and deployment of highly educated personnel.

By studies at the company level of existing induction programmes and supplementary education for highly educated personnel we may find strong indications of changes in job requirements and career patterns. Many advanced companies find it necessary to introduce young engineers to modern techniques which are not taught in many schools of technology. Some of these techniques are, for example, automatic process control, computer control and modern information technology. In some cases companies and leading institutes of technology are co-operating in such programmes. Such co-operation may often have a reciprocal effect in schools and companies.

If we study the existing programmes of supplementary education in companies we may quite often find that engineers will have to be trained in cost control, in marketing research, in organisation theory or personnel management. This can take place in external or internal courses and occur at different points in the career. We may also find that certain occupations tend to merge with other occupations in specific project groups or in staff work. We have the feeling that this may become a general characteristic of work organisation in companies as well as in research establishments where already inter-disciplinary co-operation is becoming increasingly important. If we know more about actual trends in company practices we may be able to devise a better basis for predicting the medium and long range adjustments in education and in manpower deployment and utilisation.

Apprenticeship and gradual selection as part of professional education

In the Norwegian educational system apprenticeship has been a prerequisite for entering a school of technology. One purpose of this arrangement is to introduce the students to actual industrial situations. The technological aspects of such orientation tend to be of limited value since the techniques that students at this level can understand are often obsolete. A more important purpose of apprenticeship is to enable the young student to be acquainted with the organisational context in which he is going to work. During a phase of job orientation, young students and practising engineers could meet to explore the actual job content and the different phases in the career of engineers. Apprenticeship of this kind could be split up and introduced before and between main phases of professional education. This might be a way in which to create transitional phases between different levels of education. Such a programme would have to be planned and carried out in close co-operation between schools of engineering, professional societies and leading companies. One effect would probably be a more realistic orientation among students of engineering, - orientation toward future education and for career possibilities. Another equally important effect could be the feedback from such orientation programmes into the organisations and institutions involved. It is impossible to give orientation unless ends and means are made explicit.

Industrial organisations as well as educational institutions can learn from analysing and communicating information about themselves, what they stand for in terms of objectives and programmes.

The general trend in professional education seems to be a strengthening of basic subjects, at least during the first part of study. There are two very good reasons for this trend. The first is that basic studies are necessary for later specialisation. The second reason is that basic education will tend to become obsolete at a slower rate than specialised training. As we have indicated already there are good reasons to arrange systematic gradual selection in professional education. One reason is that critical selection must be avoided before personal interests and motivations can become manifest. Another reason is that gradual selection will in most cases improve the prediction value of the selection procedure in terms of later academic or professional success. A final reason is that gradual selection combined with gradual specialisation and continuous orientation about trends in professional careers will open new possibilities for short - and medium - range adjustments in the total system of education and in the utilisation of highly educated personnel.

In our present research and development work we hope to include systematic studies of apprenticeship and gradual selection as important aspects of professional education. Again we would hope to arrange systematic feedback of results to the organisations and institutions involved. This may furnish industry and education with a better basis for continuous organisational and institutional adjustments.

Periodic revision and experimental programmes in professional education

If we attempt to revise professional education we shall soon be faced with some basic organisational and institutional problems. Academic institutions are fairly closed systems. Some of these problems are related to the system of selection and promotion of academic personnel; others to the decision-making process within academic institutions. Perhaps the basic dilemma is that we have little systematic knowledge of the nature of institutional leadership in universities. Such institutions can no longer survive as closed systems in a world where education and research is becoming an increasingly important factor in economic growth. At the same time universities are supposed to be important carriers of values other than those attached to economic growth. The fact that universities are the centres for applied as well as fundamental research and for professional as well as academic education creates considerable value conflicts in universities. This may be a major reason for a general resistance to change. And when changes do occur, considerable pressure from outside coupled with tensions inside the university are inevitable.

Periodic revisions of university curricula every fifth year as a matter of policy may be necessary to achieve a complementarity between professional training and scientific development and the demands of industry. Herbst has emphasized the importance of the time lag between educational revision and the ultimate effect of such revision in industry. The changes in professional training which could have been made in the 1950's as a consequence of the breakthrough in atomic research and in transistor technology will have no major effect in industry before the late 1960's.

If we are now facing a breakthrough in biological sciences and in space and ocean technology we must try to introduce appropriate reforms in professional education very soon if we are going to expect results in industrial production in the 1970's. An important research task ahead of us is to have much more specific knowledge about the time lag between a scientific innovation and the eventual effect on professional training and industrial practices.

Stemerding has illustrated that new professional schools are obviously much more flexible than older schools in developing educational curricula in meeting current demands raised by professional societies and industry. The introduction of social science subjects in engineering is a case in point. As we have pointed out, it seems important to include such subjects to meet the non-technical needs of industry and to avoid professional conflicts when the engineer faces administrative problems.

If we analyse the social science results of organisational change in large industrial companies we shall find that field experiments are important. It is quite likely that change in academic institutions can be easily introduced in the same way. This would probably mean that young teachers with recent training in basic sciences and with systematic information of technological change in industry could be left free to introduce experimental training programmes, rather than to have to fight for the introduction of new subject matter in old programmes.

Another alternative is that teachers in basic sciences bring their students in direct contact with industrial organisations where there have been important advances. But solutions along these lines are simply not realistic unless new sets of relationships are set up between companies, universities and professional societies. To establish new relations between institutions is always a long-term proposition. There is, however, strong pressure for new relations to develop. Strong economic pressure exists and there is also considerable willingness among members of the institutions involved.

IV. A brief summary of some policy problems and some elements of an action programme

The basic policy problems that emerge from the analysis of education and utilisation of highly educated personnel in Norway are essentially the same in all industrialised countries. The reason for this is that education represents values in itself and is at the same time an increasingly important factor in economic growth. Economic growth is a necessary condition for social and cultural development in general. But this does not mean that culture values represented in education of a certain culture may not be endangered if education is adjusted primarily to satisfy industrial and other economic needs.

Traditionally, education was classified as consumption. To-day, it is also looked upon as investment. Both classifications cover essential aspects of education and indicate the nature of the policy problems involved. Within the framework of this paper these aspects of education are essential in a policy discussion:

(a) What values does education stand for? What are the aims of education, its objectives, the self-evident good things that can be pursued through education? The content of educational programmes represents values pursued and indicates at the same time the ways in which the values are institutionalised. (To accept education as institutional means in fact that the values of education are integrated with the value system of society at large).

(b) What roles - professional and other - does education prepare people for? In traditional society there existed three relatively closed institutional systems:

(i) The school system: consisting of a relatively few well-defined levels, each corresponding to a social class with a certain status;

(ii) The system of higher education: consisting of relatively few and almost closed and stable fields of learning or departments of study;

(iii) The occupational system of industry: consisting of relatively closed stable jobs and career lines.

The integration of these three systems to the extent necessary was achieved through the long-term mechanisms operating in the labour market. These mechanisms in the past were geared to a situation with a surplus of labour and economic selection operating in education. Since education was not primarily perceived of as investment for economic growth, certain innovations in industry and the occupational system were slow in coming about. Education was perceived of primarily as a cultivator of values and intellectual activities among people in a static society, thus changes in education were slow and infrequent.

From a personal point of view, it seems self-evident that the three systems mentioned above should correspond to the developmental phases in the life of the individual. This would call for a certain integration of the three systems. Lack of integration in this respect could more easily have been accounted for than to-day by a transitional period introducing the person to a new system and a new developmental phase. To-day there is less room for such transitional phases since school and higher education take longer and there is a relative shortage of highly educated personnel.

In the early 1960's some basic changes could be observed in Norway:

(a) The educational system was "invaded" by the large new age groups from a different social strata. Such age groups wanted longer and better education in partly new fields of learning for partly new jobs;

(b) There was no longer a surplus of labour;

(c) Economic selection did not, as before, regulate the access to education or to trade and professions. The ideology and social system of the Welfare State was making its way into education and industry in a period with rapid scientific and technological change.

During the early 1960's the Institute for Industrial Social Research at the Norwegian Institute of Technology made a number of exploratory studies of the education and utilisation of engineers. Lack of integration between the school system and the system of higher education was observed in several ways:

(a) The evaluation system in schools seemed mainly to stimulate such activities as would prevent failure in the school system. It did not stimulate much active search of knowledge according to personal ability and interest.

(b) The selection for higher education takes place at the [illegible] of the school period on the basis of school grades. The [illegible]ency of this selection is highly questionable. All activities during the late school period are directed towards the selection aspect and not towards orientation for the choice of higher education and career.

(c) The value system and the norms cultivated in secondary schools did not correspond very much to those experienced by the young student entering a school of engineering. The values and norms of higher education came as a shock.

(d) Conflicts were experienced between values and norms within the institution of higher education partly because of a competition between representatives of highly specialised fields of teaching, and partly because of a conflict between academic, industrial and personal values.

It was also discovered that there was a lack of integration between higher education and the occupational system within industry.

(a) Conflicts are experienced in the career of engineers because expectations cultivated in higher education correspond little to the role structure and career patterns of industry. There seems to be little correspondence between the job content of engineers and personal value orientations.

(b) Systems of higher education are adapting themselves to changing requirements in science and industry, but the way in which the changes take place leave little hope that they will meet the needs of to-morrow.

If the observations summarized above are valid, we should be aware of the fact that:

(a) We are dealing with institutions which are no longer closed. The need for integration is obvious;

(b) Institutional changes include changes in value systems, norms of behaviour and social structure. Social research indicates clearly that the time lag in such changes is so long that planned changes with the hope of better integration must be based on prediction of social and industrial change during the next 10-15 years rather than 5-10 years. Research is needed to clarify such time lags and the basis for long-term predictions.

(c) Planned change at the institutional level in education would require leadership in schools and higher education to a degree which is still uncommon in academic life. Existing leadership is currently diverted from its primary tasks because of the demands for internal regulation created by institutional growth in quantitative terms. Institutional leadership in education can hardly be achieved unless the adjustment between the institution and its environment becomes the primary task of leadership.

(d) Planned change on the institutional level in industry will demand a greater interplay between industry and education because values cultivated in education do not and should not exclusively correspond to values cultivated in industry. Industry will be increasingly dependent upon education as a basis for innovation and as a preparation for professional roles.

The consequences that policy makers could draw from the main points emphasized in this paper are:

(a) The conditions for institutional leadership in education and industry should be examined thoroughly and systematic experiments are needed to improve the mechanisms of change in terms of educational content, the content of jobs and the professional career patterns.

(b) Planned institutional changes will have to be so slow and complicated that better integration within systems of education and between education and industry should also be accounted for by introducing transitional phases in professional training, and in careers. Such transitional phases will increase the short and medium range adjustments that can be achieved on an individual level.

(c) The selection and evaluation system of education and industry must be arranged to function step-wise and be combined with flexible transfer lines in educational programmes and industrial careers.

(d) Qualitative changes in education and industry can partly to some extent be created at a decentralized level by:
- educational institutions
- professional societies
- industrial organizations.

Representatives of the three institutions mentioned will hardly change their decision making and their values and norms on the basis of conferences or committee reports. Rather one should try to create additional institutional roles for educational leaders in professional societies and in industry, additional roles for professional leaders in education and industry and for industrial leaders in education and professional societies. These additional roles should be designed to facilitate boundary control between the three kinds of institutions. Such boundary control is particularly important in periodic revisions that ought to be introduced to restructure educational programmes and the jobs and careers of highly educated personnel.

THE EVOLUTION OF THE TASKS AND FUNCTIONS OF ENGINEERS

Presented by F. Halden,
Director, The Swedish
Employers' Association (Sweden)

This is a summary by the Secretariat of a study on the Utilisation of Electrical Engineers in Sweden. The study was originally undertaken by "Handelshögskolan" in Gothenburg under the direction of Mr. Sigvard Rubenowitz.

The Tasks and Functions of Electrical Engineers in Sweden

This paper considers the two following questions:

(a) Are the engineers of to-day adequately utilised with respect to their education, and, conversely,

(b) do the engineers have an education adapted to their job functions?

These questions are particularly important in view of the increasing demand for engineers and technicians. The analysis is based on questionnaires sent to half the total of Swedish electrical engineers in 1963. The project was undertaken by the personnel administration section of "Handelshögskolan" (business school) in Gothenburg under the direction of Sigvard Rubenowitz. In this paper only the most important questions are dealt with. A more detailed presentation is available at the "Handelshögskolan". We hope that the material presented here will create a stimulating and constructive debate.

The aim of the project

During the past few years the lack of highly qualified engineers and technicians in our country has become more and more acute. Different measures have been taken or planned to alleviate this situation within the framework of our national resources. The number of students accepted by the technological faculties in Stockholm and Gothenburg has increased considerably and a new technological faculty has been set up in Lund while at least another one is being planned. According to available forecasts, the demand for engineers and technicians will not be met within the near future, so that it might be necessary to try other solutions to this problem.

An administrator should ask himself: to what extent is the expensive educational capital invested in our university graduates utilised? To answer this question, the concept "lack of engineers" must be fully understood. The general belief is that the technical knowledge taught in the technological faculties is insufficient, but we know by experience that there is a shortage of people to occupy posts considered to be technical or have traditionally required technical education.

If such personnel appear to make only limited use of their technical knowledge, the administrative as well as the educational aspect of the question should be considered. Administratively, for example, one could try to relieve the engineers as much as possible of nontechnical tasks, and so make available more technical expertise. Some posts, traditionally occupied by engineers, might effectively as be occupied by staff with other educational backgrounds e.g. business economists. This, of course, presupposes that such a restructuring of the highly qualified personnel could be carried out without changing the career possibilities of the engineers.

From the educational point of view, one might consider new alternative branches at the technological faculties with emphasis on those elements of a nontechnical nature indispensable for many engineers in their work. These branches would make less use of the limited laboratory and machinery facilities in the faculties. This would not only help satisfy industry's demand for well prepared university engineers, but allow more students to be admitted to the technological faculties. The introduction of special "industrial faculties" with a special economic-engineering education, might be considered.

The above proposals are realistic only if the data prove that the lack of engineers is not the same as a real scarcity of technical knowledge in our country. For this, the types of activity and levels of responsibility at which engineers are currently engaged, must be made clear This

has been done here for one category of qualified engineers, i.e. electrical engineers.

Short description of methodology

For practical and financial reasons the inquiry had to be restricted to electrical engineers. The Association of Swedish electrical engineers has 3,120 members with a degree from a Swedish technological faculty. Engineers graduated in 1925 or earlier could be excluded from [illegible] survey since most of them are no longer economically active. All grad[illegible]s leaving in _even_ years from 1926-62 were sent questionnaires. Before the final questionnaires were sent out one small pretesting was done with a limited number of engineers. The final questionnaire was received by 1,337 engineers. In all 909 replies were received, i.e. a response rate of 68%. For various reasons 17 of the replies had to be rejected, so that the final analysis covered 892 questionnaires.

Classification - Type of activity and level of responsibility

Respondents were asked to define their present functions and the answers were classified according to two principles, namely type of activity and level of responsibility.

The different types of activity were:

(a) Production.	4[illegible]7 engineers
(b) Research	75 engineers
(c) Consulting activity	20 engineers
(d) Sales	67 engineers
(e) Teaching	77 engineers
(f) Administration	139 engineers
(g) Others (mainly those doing military service).	27 engineers

For coding the level of responsibility, the classification used by the Confederation of Swedish Employers and the Association of Swedish Industrial Employers was applied as follows:

Level 1

Usually comprising executive managers in enterprises with more than 100 employees . .	73 engineers

Level 2

Usually comprising executive managers in smaller firms and managers of larger departments in big industrial firms.	196 engineers

Level 3

Heads of smaller departments and heads of divisions in bid industrial firms . . . . 171 engineers

Level 4

Heads of sections or corresponding in industrial firms . . . . 144 engineers

Level 5

Younger engineers in industrial firms . . . . 232 engineers

The age of respondents

The average age in the six functional groups is shown in Table 1.

Table 1

Average age in different functions

(types of activity)

Type of activity	Average age
1. Production.	37
2. Research	33
3. Consulting activity	43
4. Sales	41
5. Teaching	36
6. Administration	45
Overall average.	38

Education before studies at the Faculty

Of the respondents, 80% had graduated from General Gymnasium ("Studentexamen") and 16 % from Technical Gymnasium while 4 % had other education. There was no systematic link between the type of pre-university education on the one hand, and the type of activity, level of responsibility or whether in public or private enterprise on the other.

The allocation of time to different duties

Four questions in this survey are of special interest. The electrical engineers were asked how their working hours were split up according to the different types of duties. Table 2 below gives an overall picture of the average allocation of time to different duties for the total group:

Table 2

Average % allocation of time to four main categories of duties (all respondents)

1 Conferences and meetings.	13 %
2. Teaching, personnel administration and clerical work. . .	29 %
3. Economic questions	12 %
4. Technical questions	46 %
Total	100 %

Technical activities

The 46 per cent of the time spent on technical questions was distributed among the following activities:

Table 3

Time spent on technical questions

(per cent)

Fundamental research	9 %
Construction and development	25 %
Processing	4 %
Maintenance	8 %
Total	46 %

The average allocation of time for respondents belonging to different types of activities and different levels of responsability is shown in Tables 4 and 5:

The time allocated to technical questions decreases as the level of responsibility rises, and the way of dealing with technical questions changes with the level of responsibility. Of those engaged in construction and development, for instance, 66 per cent at level 1 indicated that they

Table 4

Allocation of time on technical questions by engineers engaged in different types of activity

Type of activity	Average allocation of time (per cent)				
	Fundamental research	Construction and development	Processing	Maintenance	Total
1. Production. . .	6	34	5	10	55
2. Research . . .	40	22	2	4	68
3. Consulting activity	10	40	5	1	56
4. Sales	0	6	2	3	11
5. Teaching . . .	14	6	1	3	24
6. Administration .	4	12	3	7	26
All activities . . .	9	25	4	8	46

Table 5

Allocation of time on technical questions by engineers at different levels of responsibility

Level	Average allocation of time (per cent)				
	Fundamental research	Construction and development	Processing	Maintenance	Total
1.	4	12	3	6	25
2.	6	15	4	9	34
3.	5	21	4	8	38
4.	6	33	4	6	49
5.	17	36	4	8	65

deal with the initial stage only, 52 per cent at level 2, 39 per cent à level 3, 28 per cent at level 4 and 17 per cent at level 5. Correspondingly, the time devoted to concrete construction and development work is greater the lower the level of responsibility: thus 9 per cent at level 1, 19 per cent at level 2, 32 per cent at level 3, 40 per cent at level 4 and 56 per cent at level 5. The same tendency seems to be valid for other types of activities (research, processing and maintenance).

Some comprehensive data on the allocation of time to different duties by engineers at different levels of responsibility and in different types of activities

Table 6

Time allocated to different duties by level of responsibility

(per cent)

Duties	Level				
	1	2	3	4	5
Meetings	25	15	15	11	6
Correspondence	22	24	22	19	17
Personnel administration	8	6	4	3	1
Teaching	1	3	11	6	4
Economic questions	19	18	10	12	7
Technical questions	25	34	38	49	65
Total	100	100	100	100	100

Tables 6 and 7 bear out our remarks concerning the engineers relative share of technical duties, i.e. that it decreases the higher up he becomes in the hierarchy. At level 5 about 65 per cent of the time is devoted to technical duties while at level 1 (the highest) only 25 per cent. Thus, conferences, report writing, correspondence, personnel questions, economic questions account for three-quarters of the working time at top management level. The allocation of time to different duties also varies according to the types of activity. The highest percentage of time devoted to technical questions is found in research (60 per cent) while those engaged in sales activities devote only 11 per cent of their time to such tasks as shown in Table 7.

Table 7

Time allocated to different duties by engineers engaged in different types of activity

(per cent)

Duties	Type of activity					
	Production	Research	Consulting activities	Sales	Teaching	Administration
Meetings	13	7	16	13	2	19
Correspondence	15	19	17	30	22	26
Personnel administration	7	2	2	4	2	6
Teaching	1	2	1	1	48	2
Economic questions	9	7	8	41	2	21
Technical questions	55	68	56	11	24	26
Total	100	100	100	100	100	100

The application in this job of the technical theory acquired during the engineers education

The answers supplied to the question: "To what extent did you in your daily work during 1962 use the following methods or elements acquired in your technical education? (The word "use" means that either you yourself carried out the operation or that you controlled or took part in the operation)", showed that as much as 70 per cent of the technical theory acquired during his education are never used by the engineer in his work. Here too, there was a direct link between the percentage given and the level of responsibility: the higher in the hierarchy the less use of technical theory in the daily job.

For the different types of activity, as was to be expected, the engineers engaged in research made the most use of their technical theory (about 40 per cent) while the lowest figure was recorded in sales activities where the average figure was about 10 per cent.

Many respondents declared that they could do their work well without using any of this theory.

Spare-time work

Any analysis of the tasks and functions of electrical engineers should include information on the frequency of spare-time work. It appeared that 30 per cent of the respondents in public firms had such extra work, while only 17 per cent of those employed in private firms. This difference

is significant. Of the 858 respondents who answered the question, 23 per cent said they were doing extra work of some kind. The average time per week devoted to extra work and the percentage of respondents doing so for each type of work are shown in Table 8 below:

Table 8

Average number of hours per week devoted to different types of extra work

Kind of extra work	Hours per week	Engineers with extra work as % of total respondents
Teaching.	6.0	15
Consulting	6.2	4
Board meetings in other firms or organisations	2.3	2
Writing (articles, etc.)	3.3	1
Combination of extra work (2 of those areas mentioned above)	12.9	1

Teaching seems to be the most important outside activity of the engineers engaged in research, 48 per cent had some kind of extra work (40 per cent in teaching). Engineers engaged in sales and consulting are devoting the least time to extra work (5 and 6 per cent respectively).

Summary remarks

The aim of this survey was to throw some light on the question: "to what extent do employers utilize the expensive educational capital invested in our university engineers?" Hypothetically, it was assumed that many of our university engineers make use of their technical knowledge to only a limited degree and that the so-called "lack of engineers" might completely or partly be eliminated through administrative measures.

The survey - of which the most important results have been given in this paper - was of an explorative nature and intended simply to provide facts for a debate on this question, but not to make a more thorough analysis and interpret the results. There may, of course, be many different points of view concerning the "lack of engineers", and it must not be forgotten that the survey covers only electrical engineers. For this category, however, the results should prove representative.

The hypothetical assumptions mentioned above are borne out by the responses received, i.e. for large categories of electrical engineers the time devoted to technical tasks is relatively insignificant. An analysis of the extent to which engineers make use of some of the obligatory elements of the education provided in technological faculties indicates that qualitatively also technical knowledge is often underutilized.

This survey shows that the relative share of technical duties decreases the higher up in the hierarchy one becomes. Younger, unpromoted engineers deal with technical questions almost 70 per cent of their time. For engineers in top management positions the corresponding figure is only 25 per cent.

This does not mean, of course, that technical knowledge is less important at higher levels of responsibility. The 25 per cent may be a prerequisite in order to carry out the work efficiently. On the other hand, it is obvious that engineering education to-day covers only to a very limited degree non-technical subjects, whereas from the point of view of profession work, such subjects are very important.

The results of this survey give rise to many interesting questions, e.g. if the majority of engineers need more education in administration where and when should they get it? There may be alternative answers to this question, e.g. special "Industry Faculties", additional technical education in the Business Schools, more administrative education in the technological faculties or special administrative branches in these faculties, or possibly administrative further education after five or ten years.

Other problems are connected with this question: How can gifted engineers advance financially and in their career without necessarily getting increasing administrative work? In other words, what alternatives to the prevailing career patterns are feasible? Such questions would justify a serious debate between representatives of Education, Industry and the Government.

A STUDY OF ENGINEERING RESPONSIBILITY LEVELS
IN THE UNITED KINGDOM

by J.G. Orr
Secretary, The Engineers' Guild - London

I. Introduction

Object

The object of the study is to establish criteria for the definition of professional engineering work, and for this purpose.

(i) to identify the principal levels of engineering responsibility, covering the whole range from immediate post-graduate to the highest technical level, by reference to qualifications, duties, supervision received and exercised, and any other relevant factors;

(ii) to analyse typical appointments in engineering technology, to formulate job descriptions in each case, and to classify them according to the definition of levels of responsibility previously drawn up.

Method

The Guild was invited to carry out the work in December 1964, on the basis of some preliminary work which had already been undertaken. It was decided to call on the experience of engineers and of persons with a background of personnel work, from a representative range of fields

in which engineering work is done, and for this purpose to form a committee to be responsible for the conduct of the study. Discussions with commercial and industrial organisations confirmed that there was widespread support for the task, and the committee, known as the Advisory Committee on Engineering Responsibility Levels, was formally constituted in March 1965 (1). During the remainder of the year the Committee met five times and considerable progress has been made as described in this report. The work so far carried out has confirmed the belief of the Committee in the importance of the study and the practicability of achieving its objects, but a substantial part of the work still lies ahead and inevitably it will be some time before any final conclusions can be formulated.

II. Other work in this field

The most detailed and sustained work already done in this field has been carried out by the professional engineering bodies in Canada, particularly since 1957. Although this work had as its object the presentation of information about current salary levels, it was linked specifically with the question of productivity and thus with the effective use of engineers. Definitions of levels of responsibility have also been made for engineers in Australia and the United States of America, and for architects by the Royal Institute of British Architects in the United Kingdom.

The Canadian work in this field was started in 1953, when a firm of management consultants was retained to assist the Association of Professional Engineers, Ontario, in studies of the application to its purposes of job evaluation methods. A number of job specifications was produced, based on a "departmental" classification of engineering jobs, namely Research and Development, Design, Construction, Maintenance, Production (or Operation), and Sales. Although the first work was done in the electrical field, the job specifications were gradually broadened to typify engineering functions in a much wider field. These specifications were used in 1954 and 1955 for prototype surveys, but the point-rating techniques employed were not satisfactory and an exhaustive study failed to discover any other point-rating or factor comparison method which could be applied across the wide spectrum of professional engineering.

During 1956 attention began to be concentrated on the possibility of creating a method of ranking jobs by responsibility level, and in 1957 the survey techniques which had been developed were subjected to the

(1) The members of the Advisory Committee are drawn from the following bodies: The City of Westminster; Shell-Mex and B.P. Limited; The Department of Mechanical Engineering, University College, Cardiff; The School of Management Studies, The Polytechnic; The Inner London Boroughs (Organisation and Methods) Committee; The Glacier Institute of Management; The Laporte Group of Companies Limited; The English Electric Company Limited; Richard Costain (Civil Engineering) Limited; The British Broadcasting Corporation; Sir William Halcrow and Partners; Unilever Limited; and the Engineers' Guild.

critical appraisal of a large group of company personnel officers at an all-day conference. Arising from these discussions, an Advisory Committee on Salaries and Productivity of Professional Engineers was created with the following terms of reference:

(a) to develop improved job specifications, or improved descriptions of grades of difficulty of engineering jobs;

(b) to explore the possibility of grading and establishing relativity between engineering jobs;

(c) to explore means of unifying salary surveys;

(d) to investigate standards of performance and productivity of professional engineers.

The proposals of the Advisory Committee were endorsed by a second conference in 1958 and have since formed the basis of surveys which were carried out initially in Ontario and Quebec, and more recently in British Columbia and Alberta as well. The report on the 1963 survey was an analysis of the salaries paid 11,312 Canadian professional engineers by 172 organisations in the four provinces.

The Classification Guide of Engineering Responsibility Levels, which was drafted by the Canadian Committee and first used in the 1958 survey, has been used with only minor amendments ever since, and its practical application in Canada seems therefore to be established. The Guide is reproduced as an appendix to this report, with the agreement of the Canadian Council of Professional Engineers, and the very great help which it has been in providing the starting point for the present study is gratefully acknowledged.

Special machinery exists in Australia under which, since 1961, the salaries of professional engineers in a wide range of public and private fields of employment have been determined by awards of the Commonwealth Conciliation and Arbitration Commission. Each of these awards has defined the classes of engineer with which it deals by reference to their level of responsibility; the definitions used are similar to, and in some instances identical with, those used in defining the corresponding level in the Canadian Guide. In the United States a detailed classification of job definitions for graduate engineer posts has been formulated by the Bureau of Labor Statistics of the Department of Labor, and this is used to ensure comparability of job content between posts covered by its National Survey on professional, administrative, technical and clerical pay.

It is notable that the factors used to define the levels of responsibility are virtually the same in each of these three classifications - namely, duties; recommendations, decisions and commitments; supervision received; leadership authority and/or supervision exercised; and entrance qualifications. Although the Australian definitions are limited to four levels, the two highest levels in the Canadian guide are not covered; on the other hand the definitions used by the Bureau of Labor Statistics cover all posts below the level of chief engineers of companies with large engineering organisations, and comprise eight grades.

A grading structure for levels of professional engineering work has been used by the National Society of Professional Engineers in the United States at least since 1952, in connection with its biennial surveys of engineers' salaries, but the respondents have simply been asked to identify

the grade applicable to the position which they held. The Royal Institute of British Architects has similarly asked respondents (in this case, architects) to identify their own level of responsibility, as part of a survey carried out by postal questionnaire in 1964; more detailed information was also requested which enabled the assessors to apply a points system as an independent check on the level selected. The results are referred to below in connection with future work on the present study.

III. Conduct of the study

The following programme was adopted by the Committee at its first meeting:

(i) to prepare a draft classification of responsibility levels in the United Kingdom;

(ii) to check this draft classification through research in sample firms, including some represented on the Committee and others typical of different fields of engineering work;

(iii) to revise the draft classification in the light of the results of this research;

(iv) to analyse and classify typical engineering appointments and to formulate job descriptions in each case;

(v) to check the draft job descriptions through research in sample firms;

(vi) to revise the draft job descriptions and classification in the light of the results of this research.

The Committee considered whether it would be preferable to attempt to draft a fresh definition of responsibility levels, or whether the Canadian Classification Guide should be taken as a starting point and its application to conditions in the United Kingdom tested by reference to particular posts known to members of the Committee in their own organisations. It was decided to adopt the Canadian Classification as a provisional draft, particularly in view of evidence that this has influenced similar work in other countries such as Australia, and to examine it initially by reference to the experience of members of the Committee and subsequently through research in other organisations. It was agreed to omit the "Guide to Entrance Qualifications" for the time being, but the minimum level has

been taken as equivalent to graduate membership of a member Institution of the Council of Engineering Institutions (1).

Analysis of job descriptions

In order to help in giving further consideration to the classification of responsibility levels, members of the Committee were asked to supply job descriptions for a range of actual engineering posts in their organisations. In addition this task gave an opportunity to test the draft classification against United Kingdom conditions, and participating firms were asked to identify the appropriate responsibility level for each job description, and to draw attention to any difficulties disclosed. In all, 74 job descriptions have so far been produced and examined, and these have been divided as follows:

Responsibility level							Total
A	B	C	D	E	F	Above F	
6	5	17	22	12	10	2	74

No difficulty was apparently experienced by firms in identifying the responsibility levels as defined, nor, generally, in relating these to the firms' structure. It has also been possible to relate the responsibility levels to functions as different as, for example, maintenance and

(1) The following institutions are members of CEI:

The Royal Aeronautical Society
The Institution of Chemical Engineers
The Institution of Civil Engineers
The Institution of Electrical Engineers
The Institution of Electronic and Radio Engineers
The Institution of Gas Engineers
The Institute of Marine Engineers
The Institution of Mechanical Engineers
The Institution of Mining Engineers
The Institution of Mining and Metallurgy
The Institution of Municipal Engineers
The Institution of Production Engineers
The Institution of Structural Engineers
The Institution of Naval Engineers

consultancy. The number of levels seems on the whole to reflect divisions which are broadly recognised in the firms covered.

Two-thirds of all the job descriptions produced were classified in grades C/D/E, and a similar distribution appears in the job descriptions for each firm. The reason for this concentration seems to be that these are the main engineer grades in which the greater part of the high level technical work is done, and they cover a very wide range of salaries. Even within the single grade C there may be two levels of engineer, one using established practices and the other devising and initiating new practices. Grades A/B are not professional grades, but temporary lodgements through which a professional engineer will normally pass and including work which can be carried out by a competent technician. They are essentially training grades, and some doubt has been felt whether there exist identifiable and significant differences between them. Finally, as A/B represent the training grades and C/D/E the professional engineer grades, so F and "Above F" represent the technical managerial grades. The desirability of adding, at each grade, a factor to cover the element of creativity has been considered and noted for future examination.

A point which had to be considered at the beginning was whether levels of responsibility could in fact be classified in a form applicable to all fields in which professional engineering work is carried on. The work undertaken so far in connection with the grading and analysis of particular job descriptions supports the Canadian experience and suggests that the production of such definitions is a practicable aim in this country. This view is also borne out by the Australian and United States experience referred to above. At the same time it has to be recognised that the more comprehensive the classification the more general is bound to be the result, and there may be scope for sub-division within this overall framework.

Three obvious sub-divisions are by engineering function, by field of work, and by size of undertaking. The activities carried out by engineers can be grouped under different functions, and it is significant that the Canadian work as described above began with a "departmental" classification which was eventually developed into the existing comprehensive guide. The progress of the study so far suggests that sub-division by field of work is not necessary in the first instance; no difficulty has been experienced, for example, in grading within a common classification posts in local government, broadcasting, construction and the process industries.

More difficulty has been experienced in relating the factor of size to level of responsibility. This involves the size of the undertaking and of the part within it for which and individual is responsible, in terms both of number of employees and of finance. It is clear that neither financial accountability nor numbers of subordinates is a conclusive guide by itself, and perhaps a better measure of responsibility is the range of possible decisions and initiatives open to the individual, and their effect on the health of the organisation. It is also important to bear in mind that, in common with most other studies of this kind, information has principally been obtained from large organisations; on the other hand ninty per cent of the firms in the mechanical engineering industry, for example, are relatively small ones which have different characteristics, and this point has been noted for further study.

Analysis of the job descriptions has also emphasised the distinction between the technical and managerial responsibilities in a given engineering

role. Management is an activity which permeates all the functions performed by engineers, and it is present in some degree at all levels of responsibility. The terms of reference for this study are "to establish criteria for the definition of professional engineering work", but there is a distinction between the engineering content and the total content of the work done by engineers. Difficulty has also been experienced in assessing those posts in which the technical and managerial functions appear to involve different levels of responsibility, and in classifying posts above level "F" in view of their frequent general management component. In addition, it is necessary to stress that the present study does not cover the position of engineers who move completely into general management, including top management, this is an important field of work for engineers, which is superimposed into the levels under consideration here.

The Canadian Classification Guide defines each level of responsibility by reference to five factors - namely, duties; recommendations, decisions and commitments; supervision received; leadership authority and/or supervision exercised; and entrance qualifications - and the job descriptions supplied to the Committee have been analysed to see how far these or other factors are used. In virtually all cases the first four Canadian factors are employed, although "supervision received" is usually limited to a statement of the person to whom the holder of the job described is responsible. This contrasts with the Canadian Guide, which is invariably more comprehensive and specific, for example in regard to the extent to which decisions are reviewed. The job summaries attached to the report, on the other hand, have been compiled from the original job descriptions in such a way as to clarify each of the five factors as far as possible.

In only about half the posts are the academic or professional qualifications required explicitly stated in the job descriptions, and in only 30 out of 74 cases are the number of years of experience specified. Even here the variations suggest that length of experience since qualification, as a requirement for a particular post, is less carefully thought out than are the other factors involved. Additional factors listed in the job descriptions are the internal and external contacts involved in the post, the possession of confidential data, and the amount of travel involved. None of these appears to be of primary importance, nor to be used in more than a minority of the firms concerned.

The majority of the job descriptions received have been reduced to a common form for purposes of comparison, and a number of these job summaries are attached as an appendix to the report.

Conclusions

The preliminary results of the study, which is not yet complete, can be summarised as follows:

(i) The levels of responsibility formulated by the Canadian Council of Professional Engineers can be applied to the conditions of engineering employment in the United Kingdom at the present time;

(ii) The descriptions used appear to correspond broadly to the levels of responsibility into which firms recognise that their organisations are divided;

(iii) The factors used to define an engineering job and its level of responsibility are substantially the same in Canada and the United Kingdom;

(iv) There are nevertheless additional factors involving, for example, the size of the undertaking, which are relevant to level of responsibility, but it will be difficult to define these in simple terms applicable to each level.

IV. Future work

The method of work adopted envisages that at a certain stage research in sample firms will be necessary, the results of which can be used by the Committee in checking and revising the draft classification of responsibility levels and draft job descriptions for typical engineering appointments. The form and timing of any questionnaire has not been decided, but it is believed that more viable results could be obtained by field research work than by postal questionnaire in the first instance.

The recent survey by the RIBA has demonstrated the possibilities and limitations of the individual approach. In this survey, the respondents were asked to provide information about projects on which they were or had been engaged, the value of these projects, the responsibility which they had for the different stages, and the number of architectural staff for whom they we[re re]sponsible; the respondents were also asked to grade themsel[ves ...] defined levels of responsibility. A points system was [...]e RIBA to enable the information given to be expresse[d ...] or other of these responsibility levels, and what wa[s ...] a reasonable distribution of the [spr]ead of responsibility between architects was recorded. On the other hand the direct assessment of responsibility levels by the respondents themselves provided a quite remarkably top-heavy distribution, and in this respect it bore out much other experience to the same effect.

V. Benefits of the study

Studies of the use of engineering manpower are of two kinds, quantitative and qualitative; official studies in the United Kingdom hitherto have been mainly quantitative, that it to say they have been concerned with present numbers and future numerical requirements. In fact, however, the use of professional engineers in the United Kingdom is particularly in need of qualitative study, because of past uncertainty about the definitions of a professional engineer and a technician, and because of the shortage of technicians and the lack of clearly defined qualifications for this level.

Even for purely quantitative purposes it is important to gain more information about the level of work currently being undertaken by the available supply of engineering manpower. If this shows, as many expect,

that a significant part of the work done by engineers could satisfactorily be carried out by technicians, it might be necessary to increase very considerably the target output of technicians. It would then become possible to free engineering talent for more creative functions.

The completion of this study will provide a yardstick of practical value in the field of utilization of engineering manpower. By identifying the principal levels of engineering responsibility an important step will have been taken towards defining the span of professional engineering work; it should then be possible to reach conclusions about the nature and amount of technical and administrative support which are desirable to enable the engineer to achieve the highest degree of productivity and work satisfaction - in other words, his most effective utilization.

By means of the analysis of typical engineering appointments and their classification in one or other of the defined levels of responsibility, it should in due course become possible to establish sufficient "bench marks" to enable both engineers and employers to define the level of responsibility involved in any particular post. This will be of particular advantage in the case of the engineer who forms part of an inter-disciplinary team. It will also enable surveys of engineers' earnings to be carried out on the basis of level of responsibility, thus providing information of greater practical value about current salaries for particular types of post.

A further benefit which should result from a study of levels of responsibility is the correction where necessary of job titles which do not properly reflect the level of work involved. The results will aid salary determination and reviews; more accurate comparison between similar levels of job in different departments and organisations; more accurate information for employer and employee when new appointments to a firm are being made; and improved status and work satisfaction for the engineer in those cases where the existing job title implies a lower level of responsibility than the job actually involves, or is so imprecise as to give rise to misunderstanding.

Similar considerations may arise in other countries which undertake studies of this type, and results of equal practical value may be achieved. It is significant that the work under review suggests a wide measure of agreement about the number and characteristics of the principal levels of engineering responsibility, in the United Kingdom and Canada, and to some extent in Australia and elsewhere as well. It is much too early to draw any definite conclusions from this, but if it should eventually become possible to define "x" levels of responsibility applicable to professional engineering work wherever this is carried on - not only in any field, but also in any country - the results would be of considerable significance for the purpose of international comparison.

VI. Examples of job descriptions

Examples of job descriptions are detailed in the following pages.

Employer	A urban local authority of 150,000 population	Branch of Engineering	Civil
		Job Function	Design and Planning
Department	Borough Engineer	Job Title	Engineering Assistant

Organisation Chart

Borough Engineer

Deputy Borough Engineer

Chief Assistant Engineer

Senior Assistant Engineer (Street Lighting and Sewers)

Senior Assistant Engineer (Highways and Traffic)

ENGINEERING ASSISTANT

Duties

To design small road improvements; to locate traffic regulation signs; to undertake site surveys, to assist on specific parts of larger schemes run by senior staff.

Recommendations and Decisions

Recommends solution which follow from the application of accepted practices.

Decisions are taken only where clearly defined procedures are there for guidance.

Supervision Received

Works under close supervision with daily checks from Chief Assistant Engineer and Senior Assistant Engineer as necessary. Quality of work, review of solutions and detailed check by CAE and SAE unless there is clear precedent from previous standard documents.

Leadership

None normally but may have services of a trainee when engaged on site surveys.

Qualifications

Recent qualification as graduate engineer with very limited experience.

Below B because: of limited experience and very close supervision given.	Interim Assessment A

Employer	An urban local authority of 150,000 population	Branch of Engineering	Civil
Department	Borough Engineer	Job Function	Design and Planning
		Job Title	Assistant Engineer

Organisation Chart

Borough Engineer

Deputy Borough Engineer

Chief Assistant Engineer

- Senior Assistant Engineer (Street Lighting and Sewers)
- Senior Assistant Engineer (Highways and Traffic)
  - ASSISTANT ENGINEER
  - Assistant Engineer
  - Assistant Engineer (Road Planning)

Duties

To design road improvements and other projects for construction by direct labour involving the application of established departmental practices and well-known technical methods to meet local circumstances, e.g. small street lighting schemes; review of street lighting proposals of estate developments; detailed work on a scheme prepared by Senior Assistant Engineer (widening of carriageway); installation of traffic signals; removal of hump-backed bridge).

Recommendations and Decisions

Recommends alternative solutions by applying well-established techniques and practices.

Supervision Received

From Chief Assistant Engineer on progress of work giving detailed direction on priorities, also on quality of work arising from close scrutiny of detailed methods and estimates. Also from Senior Assistant Engineer when necessary on costs and methods.

Leadership

No staff work to him normally.

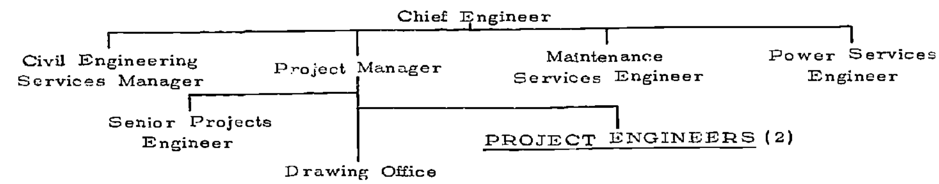
Qualifications

Professional qualification in engineering recently completed with no more than normal experience for this; or experience for 3/4 years as graduate engineer but with completion of associate membership outstanding.

Above A because: of working experience since graduation. Below C because: work prescribed and limited to solution by standard methods and techniques.	Interim Assessment B

Employer	A Subsidiary Company of an International Group largely involved in Chemical Manufacture	Branch of Engineering	Mechanical
		Job Function	Construction
Department	Engineering	Job Title	Project Engineer (2 posts)

Organisation Chart



Duties

First to examine for feasibility those requests for engineering capital projects allocated to him by Projects Manager, working under his close supervision; to test equipment, to initiate experiments and to produce a rough estimate; second, to prepare a complete plant specification with process flow charts and estimate; third, when the projects have been agreed, to control the carrying out to completion by agreed date, working to Projects Manager, accepting plant, assisting in commissioning and modifying if necessary.

Recommendations and Decisions

Recommends to Projects Manager, after close liaison and consultation with originating department and other relevant specialist works departments, and if necessary with Technical Department of parent company, the plant-flow-process charts, rough estimates, complete specification, work programme, preferred contractors, acceptance and modification of plant.

Decides details and conditions of tenders, acceptance of work maintaining technical standards, payment of suppliers and contractors.

Supervision Received

From Projects Manager, who assigns and outlines projects, reviews work for technical soundness and accuracy, and handles any unusual difficulty; also from technical specialist colleagues in other Works Departments, and from Technical Department of parent company when requested or necessary.

Leadership

Given to departmental draughtsman assigned to his projects, and to all those specialists, contractors and others who are concerned in these projects.

Qualifications

Minimum, AMI.Mech.E. and 7/10 years' experience in plant design, maintenance and operation.

Above B because:	Once project agreed, work is not supervised in detail and technical guidance must be given to engineers of lesser standing.	Interim Assessment
Below D because:	Objectives are clearly defined once project agreed; technical advice is available at all times and work is subject to technical review.	C

Employer	A subsidiary Company of an International Group largely involved in Chemical Manufacture	Branch of Engineering	Mechanical
		Job Function	Construction
Department	Engineering	Job Title	Projects Manager

Organisation Chart

Chief Engineer

- Civil Engineering Services Manager
- PROJECTS MANAGER
  - Sen. Projects Engineer and Deputy Projects Manager
  - Project Engineers (3)
  - Drawing Office (19 staff)
- Maintenance Services Engineer
- Power Services Engineer

Duties

Plan and control capital projects in all their stages; co-ordinate their progress; allocate projects to his subordinate engineers; negotiate engineering contract details; accept work and authorise payments; maintain safety standards on plant throughout factory; prepare annual capital budget; provide a design, drawing, estimating and planning service for his department and for engineering as a whole.

Recommendations and Decisions

Recommends: long-term factory and development plans; annual capital budget; projected estimates (all of which require co-ordination of work of technical specialists over a wide range of engineering work); choice of contractors.

Decides: after financial approval, all matters concerning planning and progress of projects except major changes in timing or cost.

Supervision Received

General line of approach, objectives and tentative time scale laid down by Chief Engineer and those directly associated with projects. Technical guidance, outside own field, available from speciali

Leadership

Assigns and outlines projects; reviews work for soundness of plant design from an engineering viewpoint and for technical accuracy. Responsible for selection, training and discipline of his staff.

Qualifications

Corporate membership of Institution of Mechanical Engineers, minimum of 10 years' experience in plant design of which at least 5 years should have been spent as section leader in a projects department.

Above C because:	work requires mature experience in plant design and projects co-ordination of specialist professional elements.	Interim Assessment
Below E because:	work is well defined, subject to review for soundness of judgement, and technical guidance is available.	D

Employer A Subsidiary Company of an International Group largely involved in Chemical Manufacture	Branch of Engineering: Electrical
	Job Function: Maintenance
Department Engineering	Job Title: Power Services Manager

Organisation Chart

Chief Engineer
- Civil Engineering Services Manager
- Maintenance Services Engineer
  - Electrical Engineer — 59 staff
  - 2 Electrical Draughtsmen
- POWER SERVICES MANAGER
  - Instrument/Control Engineer — 13 staff
  - Fuel/Steam Manager — 36 staff
- Projects Manager

Duties

In accordance with the policy laid down by the Chief Engineer, to provide steam, electricity, water and gas services and to maintain the plant and equipment concerned in the distribution of these services, including electrical, electronic and control equipment. To co-ordinate with Production and Works Development departments in the development, design specification and provision of special equipment including process control equipment needed for the supply and control of these services; to estimate the short-term and long-term needs; and to administer his staff and collaborate with Personnel Manager on Trade Union matters. Deputises for Chief Engineer and assists him in formulating general departmental policies.

Recommendations and Decisions

Makes recommendations on the development of new methods of process control and estimates the cost. Makes recommendations on the use of energy throughout the plant. Decides on the methods of distribution and maintenance standards on all power services and associated equipment without technical review, but must submit estimates for the expenditure of large sums of money on projects or long term objectives.

Supervision Received

Broad principles of policy laid down by Chief Engineer, who would scrutinise closely all major schemes. Specialist guidance also available from Technical Department of parent company.

Leadership

Advises his senior engineers on more difficult assignments and sets all standards of operation and maintenance of equipment under his care. Makes recommendations on the selection, training, discipline and remuneration of his staff.

Qualifications

Associate Membership of Institution of Electrical Engineers with 15 years' experience of the design and maintenance of electrical, electronic and control equipment associated with chemical processes and experience of steam-raising plant, including several years' experience at supervisory level.

Above D because: decisions not normally subject to technical review; authority in his own field.	**Interim Assessment**
Below F because: works within framework of agreed policy and subject to review of major plans.	E

Employer	A Specialist Division of an International Group largely involved in Chemical Manufacture	Branch of Engineering	Mechanical
		Job Function	Research and Development
Department	Technical (Mechanical Engineering)	Job Title	Senior Engineer (Fuel and Steam)

Organisation Chart

Chief Mechanical Engineer

- SENIOR ENGINEER (Fuel and Steam)
  - Assistant Engineers
- Senior Engineer (Automatic Machinery)
  - 2 Assistant Engineers
- Senior Engineer (Refrigeration)

Duties

In accordance with the policy of the Chief Mechanical Engineer of the group, to provide a consultancy service to associated companies in the United Kingdom in the field of Fuel and Steam covering the selection of fuels, certain building services, steam-raising and power plant installations, and water treatment; to visit overseas companies in an advisory capacity; to assist the Chief Mechanical Engineer in the vetting of Capital Proposals before submission to the Board of Directors; to prepare and give papers to professional institutions and associations; to keep himself well-informed in current technology and in long-term developments in this field and to ensure that his staff keep themselves up to date technically.

Recommendations and Decisions

Makes authoritative recommendations to associated companies on plant design, specification and investigation, and installation. Decides on fuel selection problems; on the work load of his subordinates; on plant designs submitted by contractors.

Supervision Received

Receives administrative direction and general review of work for policy and co-ordination from the Chief Mechanical Engineer, who is kept informed of this movements and authorises his visits abroad.

Leadership

Gives consultative direction to company engineers and stimulates their interest in current technology and long-term developments. Directs his own subordinates in their work and sees that they keep themselves well-informed and up to date. Reviews and evaluates all work in his field to ensure overall co-ordination.

Qualifications

Degree in Mechanical Engineering and/or corporate membership of I. Mech. E., knowledge of chemistry of fuels at Institute of Fuel level, plus 10 years' experience in more than one of the fields mentioned.

Above E because:	of the need for maturity and wide experience as the consultant authority in a sphere of major importance to the organisation.	Interim Assessment
Not above F because:	of the overall technical review and supervision for policy from Chief Mechanical Engineer.	F

Employer	A subsidiary of a large Group manufacturing Electric Machinery	Branch of Engineering	Mechanical
		Job Function	Research and Development
Department	Engineering Manager	Job Title	Engineering Manager

Organisation Chart

Subsidiary Company (DIESEL)
General Manager

Sales Manager | ENGINEERING MANAGER | Contract and Service Manager

Assistant Engineering Manager | Chief Designer | Chief Development Engineer

Duties

Within the framework of the policy laid down by the General Manager, he is responsible for Research and Development in design, planning including time and cost estimating and streamlining, and directing work of a forward type necessary for the production of diesel engines; has complete technical responsibility over related activities of manufacture and testing; maintains the necessary contacts within the Group and with outside bodies to keep himself and his senior staff fully informed on current practice and long term development in diesel engineering; visits customers when persuasion is required; visits company units in the field.

Recommendations and Decisions

Working within the broad objectives laid down by the General Manager he recommends to him his long and short term plan for developments in Diesel Engineering, together with cost. Decides all technical matters on work in hand; decides on allocation of resources to meet his work programme; resolves all priority conflicts.

Supervision Received

From General Manager, with virtually no technical guidance and control except the limits set by broad objectives and the established policies of the Company.

Leadership

Responsible for implementing his own engineering policy through supervision of his 7/8 senior engineers; gives technical advice when necessary; settles priority conflicts; approves plans and designs; ensures that his staff are well informed and up to date on long term developments; administers his staff of 150.

Qualifications

Degree in Mechanical Engineering with full Membership of the Institution of Mechanical Engineers, plus 12-15 years' experience in Diesel Engineering work.

Abve F because: he works with broad management authority receiving virtually no technical guidance and control and is responsible for long range planning and co-ordination in his own field.	Interim Assessment Above F

THE UTILISATION OF QUALIFIED MANPOWER IN INDUSTRY

by M. Blaug, M.H. Peston and A. Ziderman
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The paper itself is very much the joint product of the three authors and their assistants. Apart from the authors, the research team has included the following, as research assistants: Dr. Margaret Ager, R.J. Allard, Margaret Keogh, Dina Schwartz, Beryl Tipton and Judith Weltman; in particular the authors wish to acknowledge the substantial contribution of R.J. Allard to the research reported in this paper. The authors and their assistants have received good advice and pertinent criticism from their colleagues in the Unit for Economic and Statistical Studies on Higher Education; the authors alone, however, must take full responsibility for what follows.

The Unit for Economic and Statistical Studies on Higher Education at the London School of Economics, directed by Professor C.A. Moser, was set up in 1964 with a grant from the Nuffield Foundation. The Department of Scientific and Industrial Research (now the Science Research Council) gave the Unit financial support to carry out research

into the use of qualified manpower in industry. The Unit is also indebted to the Organisation for Economic Co-operation and Development which made it a grant to carry out further work in this area and prepare the present paper. The Unit has now received a substantial grant from the Ford Foundation to widen the scope of its work in the manpower field beyond that described in the following pages.

Finally, the authors are very much in the debt of the business firms who have welcomed them and given them access to their records. Their names are not mentioned because of the need to keep secret the sources of the data presented in the paper; yet, without their co-operation, research of this kind and resulting improvements in public policy become impossible.

Introduction

The origins of the research to be described and discussed in this paper are to be found partly in the Robbins Report on Higher Education, partly in an interest in the economics of education which has been developing strongly in the United Kingdom for the past five years, and partly in a concern with manpower planning the importance of which is gradually being recognized. While the Unit for Economic and Statistical Studies on Higher Education at the London School of Economics was set up with many purposes in mind, a major objective and one which was given high priority from the start has been the investigation of the many interrelationships between the employment of qualified manpower and industrial activities. This is what has come to be called "The Industry Project", and it is under that heading that this paper is presented.

In setting up this research project it seemed to be clear in the initial stages that there was no great shortage of theoretical analysis in this field, but that relevant empirical material was much scarcer. Moreover, the available published data was more often than not highly aggregative, and excluded so-called economic variables. The result has been that it has been impossible to test numerical hypotheses at the level of the firm, that much material on the labour force has been of little use to the economist because he has been unable to relate it to phenomena in which he is interested, and that some writers have been able to promulgate very strong statements on education and the economy without the check of empirical testing, so to speak. The decision to concentrate on the empirical, data collection and on the research process seemed to be justified, therefore, on comparative cost grounds.

The aim of the research project was to formulate and test relationships between the economic characteristics of individual firms and the educational profiles of their labour force with the ultimate highly practical purpose of throwing light on the factors affecting the requirements for people with different educational qualifications. To be done properly this would require a large sample study, first, of firms within one industry to ascertain inter-firm effects, and, secondly, of firms within several industries to ascertain inter-industry effects. A study of this kind, however, apart from being unique in the United Kingdom, must be both an extremely expensive and an extremely complicated business. It seemed sensible, therefore, both to gain the relevant experience and to anticipate major difficulties in good time (in order to overcome them at minimum cost) that we should engage in a series of pilot projects of individual firms to prepare the way for the larger investigation . It is an account of these pilot projects, both empirical and theoretical, which is to be found in this paper.

We have said that our intention was originally to emphasize data collection and what might be called the crudely empirical aspects of the research. In fact, however, a remarkable consequence of our investigation has been the formulation of new conceptual tools and theoretical hypotheses, and the sharpening of old ones. Contact with the real situation has had an immediate payoff on the theoretical side, revealing the inadequacies of pure speculation and opening up entirely new avenues for advance. Somewhat surprisingly, therefore, much of what follows is of a theoretical rather than directly empirical nature. Another point worth mentioning at this stage is that we did not anticipate getting any substantive results from these pilot projects since they were few in number and were merely being used as a proving ground for our methods. In fact, we have done rather better than that, and in one part of our work, that relating to age-earning profiles and the returns to education, we have collected sufficient data to come up with some preliminary results of genuine interest in their own right. This bonus from the pilot research was not looked for, and is to be regarded as a by-product from what were meant to be our central operations.

The pilot projects have had the following consequences:

(a) We have learned a great deal about the problem of data collection with respect to educational and economic phenomena at the level of the firm;

(b) We have examined and to a certain extent solved certain conceptual problems, such as constructing quantitative indices of educational inputs and economic performance;

(c) We have developed and discussed new hypotheses about the role of education and the use of highly qualified manpower. We are also beginning to throw new light on the efficiency of firms with regard to their hiring and employment policies. All of this is directly relevant to manpower planning;

(d) We have constructed age-education-earning profiles and calculated rates of return to education.

All of these consequences are of direct relevance to our own large sample study, and to similar studies that may be engaged in by other

researchers. It is felt that their value is sufficient both to justify such projects as a standard research procedure, and to warrant the publication of this report at this stage. Nonetheless, it is as well to emphasize here a point that will be made in a number of places later on; namely, that most of our conclusions, theoretical, methodological and empirical, must be regarded as preliminary. This is merely the beginning of research which may in toto last many years.

The paper itself is organized into a number of sections. Some of these are theoretical, some describe our more substantive conclusions; and some are concerned with our actual research experience. Although they are all aspects of the main study they must not as yet be viewed as an integrate whole. Section I is largely theoretical and is connected with the formulation of appropriate relationships and the clarification of a number of ideas. This particular section of our work we still regard as nowhere near finished, and many of the ideas contained therein are susceptible of greater elaboration and should give rise to many more fruitful hypotheses. Section II deals with the methodology of firm-level studies and offers a justification of inter-firm analysis. Section III describes in detail the actual pilot projects undertaken and deals, in particular, with the vexed problem of data collection and the approach to firms. Section IV presents age-education-earnings data for a sample of 3,000 individuals and relates age-education-earnings profiles to the career concept. Section V is devoted to occupational classifications; it also discusses the problem of job analysis. Section VI examines the problem of malutilization of the labour force and discusses what we have called the education requirement-attainment matrix. Section VII deals with the rate of return to education. Section VIII the concluding section, endeavours to show the relationship of our results to manpower planning. Concluding the paper are a number of appendices dealing with such matters as classifying educational qualifications, the costs of education, the aggregation of educational inputs.

Finally, it shoud be noted that although all the forms of analysis contained in this paper will feature in the main inter-firm study, they are subordinate to the main study's central aim of relating the characteristics of industrial manpower structure to the economic performance of industrial units. The first phase of the inter-firm study will consist of raising, during 1966 and 1967, personnel and economic data from 100 establishments in the Electrical Engineering Industry in the United Kingdom, which will allow the underlying hypotheses to be tested by multi-variate analysis.

I. Theoretical aspects of manpower utilization

The major explanatory hypothesis (or class of hypotheses) to be investigated in the Industry Project concerns the nature and strength of the relationship between the economic performance of the firm (measured in such terms as productivity or profitability) and the education of its labour force. While it would be agreed that other variables are involved as well (such as scale, and both quantity and quality of capital), it is felt that any explanation of a firm's economic performance that neglected

the education element would be less than satisfactory. Moreover, it is worth noting that in terms of a simultaneous equation model of the firm there are also subsidiary interrelationships to be sought between education and the size of firm, and capital and the size of firm. In the usual economic terminology the production function is being extended to include education in one way or other.

The inclusion of the education of the labour force in a productivity analysis of the firm is related to manpower planning and the derivation of educational goals from the needs and demands of industry. The two, however, are not the same. It is possible in principle to ascribe a major part to education in a positive analysis of the firm without this being of much use to the manpower planner; it is also possible in principle to make manpower plans without paying too much regard to the intricacies of the economic theory of production. Whether either of these possibilities in principle is likely to be realized in practice, is one way of viewing the objective of the present research project.

The manpower forecasting approach to economic planning as it relates to our research is as follows: given certain growth targets for the gross domestic product, determine the future occupational composition of the labour force required to fulfil the target, and then translate those requirements by occupational categories into requirements by educational qualifications. From this point of view the manpower forecast and educational requirements are not absolutely given but are contingent on an output forecast.

In making forecasts of this kind there are several crucial points to be borne in mind:

(i) It may not be sufficient to work on a point forecast of gross domestic product in the aggregate; instead, some account may have to be taken of its sectoral structure, and its movement over time.

(ii) It cannot be taken for granted that only one occupational structure will fulfil the ultimate production requirement. The neo-classical economist would certainly expect there to be some scope for interoccupational substitution, and for substitution between labour of all kinds and other factors of production. In this case the concept of need or requirement becomes a good deal more complicated.

(iii) The connection between occupation and education may also not be a simple one. As will be explained later there may not in most cases be a single educational requirement for each occupation.

(iv) Requirements or needs may, anyway, be interpreted either as those seen by the firm or given by the firm in answer to questions from government planners, or as calculated from the outside by experts of one kind or another. As will be seen later on, some of our research throws doubt on the validity of any contingent manpower forecasts made by the firms whether these are viewed simply as their own forecasts of their own demands or as estimates of their requirements.

It is, perhaps, also worth mentioning here that planning in this context may be approached the other way round. An attempt might be made to determine what output would emerge (or could be made to emerge under optimum conditions) from a labour force of given educational or occupational characteristics. One could, therefore, make the output contingent on education or occupational supply. In this way it can be seen that manpower planning and output planning are part and parcel of the same general activity. Whichever approach is adopted there appears to be no difference to the central relationships that need to be investigated. Also, except in the very simple case of a unique input-output relationship between education and national product, the optimization of choice problem is unavoidable. In saying this, however, it must be emphasized that very little work has been done (either by ourselves or other economists) to introduce optimization explicitly into a real planning model. The problem of efficiency also complicates the assessment of input-output relationships actually observed at the present time. If these do not represent efficient factor combinations, then an optimal forward projection involves a double optimization, so to speak, from present sub-optimal to present optimal and then on to future optimal. As will be apparent later, there is considerable evidence that firms' behaviour is not to be interpreted as revealing most efficient factor and output proportions.

Bringing efficiency into the picture also implies that we become somewhat involved with the methodological distinction between positive and normative matters in economics. On the whole the manpower planning literature tends to confuse these matters, and it is not always clear whether a particular figure put forward is a forecast of demand, a statement of optimum supply, or that peculiar (but extremely) fashionable hybrid, a projection. Whether or not the objective of a particular piece of research is to determine a possible demand for a particular year (i.e. is a projection) or a most likely demand (i.e. a forecast), it is difficult to avoid the question whether the demand is in some sense appropriate or optimal. Indeed, if possibilities are themselves functions of public policy, projections and optimality are inextricably interwoven. (A further point to note here is, of course, that what appears to be optimal from the point of view of each individual firm may not be so from the national economic standpoint).

If education is to be seen as part of the productive input of the firm, we may take account of the educational variable in a variety of ways. In the first place a decision has to be made whether to place education directly in the production function, or have an intermediate stage of relating education to occupation and occupation to output. Secondly, one must decide whether to introduce education as a variable in its own right or whether simply to classify the labour force by its educational qualifications. If the former decision is taken one is obliged to define an education index to represent this variable.

The advantage of not having a two-stage model of education-occupation-output is that one is spared the major difficulty of producing an occupational classification and placing all members of the labour force in it. The disadvantage is that it may happen in practice that the productive significance of a member of the labour force may not depend simply on the education which he has, but also on the occupation in which he is put (i.e. in the most general sense, on the way in which he is used).

It seems a sensible research task, at least in principl[illegible] attempt the occupational classification in order to determine how imp[illegible] occupation is.

Thus, at the one extreme one can build a model in which output is partly a function of the inputs of men in different occupations, and ability to perform each occupation is in turn functionally related to education. At the other extreme, one can bypass occupation altogether and replace the simple labour input measure by a crude index c[illegible] number of men multiplied by years of education. In between, many combinations of occupational classifications and education indices [illegible] possible. At the present stage of our thinking we are still proceeding along the more complex lines, but it remains to be seen how successful we shall be.

The possible connections between occupation and education may be stated more formally. It appears that there are three possibilities in principle:

(i) There is a precise educational qualification for each occupation too much or too little implies immediate disqualification.

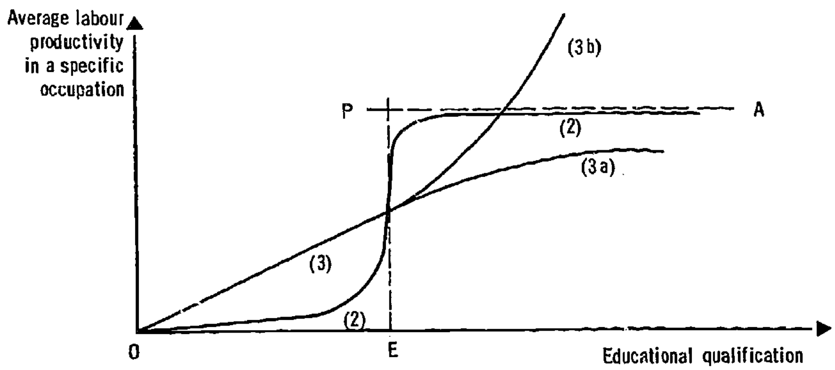
(ii) There is a minimum educational qualification for each occupation, and additional qualifications are useless.

(iii) The value of a man in an occupation increases with his educational qualifications, perhaps first at an increasing rate, and then at a decreasing rate as in the usual diminishing returns case.

These three cases relating to a specific occupation are illustrated in Figure 1 with educational qualifications measured as a scalar on the horizontal axis and productivity or performance in the occupation measured on the vertical axis.

If the real world corresponds to case (i) and (ii), no serious problem of optimization emerges. Case (ii) certainly seems to correspond to that considered in many planning models. It is essentially the equivalent within this context of the Leontief fixed coefficients assumption. If, however, case (iii) holds and, as has been remarked already, that is what the neoclassical economist would assume, there remains the problem of deciding on the appropriate level of education for each occupation. This in turn is complicated by the fact that educational qualification interacts with innate ability, work experience acquired, and on-the-job training received in determining the level of performance in an occupation. Insofar as all these other variables are conducive to improved performance, the education-productivity curve will shift upward for every increase in the associated variables. There may also be a threshold effect, as we noted earlier: without a minimum amount of education, additional experience and training make little contribution to productivity. On the other hand, the threshold effect is just as likely to run the other way: without a minimum amount of work experience, extra education contributes nothing to improved performance.

Figure 1



Case (i) is illustrated by the point P with all other points lying on the abscissa.
Case (ii) is illustrated by OEPA or, perhaps, more realistically by curve 2.
Case (iii) is illustrated by a few representative curves or, possibly, by a straight line through the origin. There will be "diminishing marginal productivity of education" whenever the curves flatten off – as in 3a.

Related to this is the question of whether education and on-the-job training turn out in practice to be complements or substitutes. Some United States evidence suggests that better educated people tend to receive a disproportionate share of on-the-job training provided by industry, presumably because they make better trainees than less educated people (1). This finding asserts, therefore, that training is complementary to, rather than a substitute for, formal schooling and stresses the importance for industry of people with a general education instead of specific vocational or professional preparation. Paradoxically enough, this weakens the case for the forecasting of specialized manpower, as also would the possibility of repairing deficiencies in formal education by labour training. At the same time it implies that the need for specific preparation in technical colleges and the like may be less pressing than has hitherto been imagined. Whilst it is true to say we are far from having any satisfactory answers to these questions, they do begin to suggest some of the considerations that are involved in a study of this kind.

Let us now turn briefly to age-education-earning profiles which are examined in greater detail in Section IV. We have collected sufficient

(1) See J. Mincer: "On-the-Job Training: Costs, Returns and Some Implications", in "Journal of Political Economy", Supplement: October 1962, pp. 59–60.

data to be able to present some actual examples of these and have therefore been obliged to consider their significance. The questions that need to be examined in regard to these profiles are the following:

(i) Do they typically increase with age and, if so, do they do so at an increasing, decreasing, or constant rate? Related to this, do acquired skills tend to become obsolete?

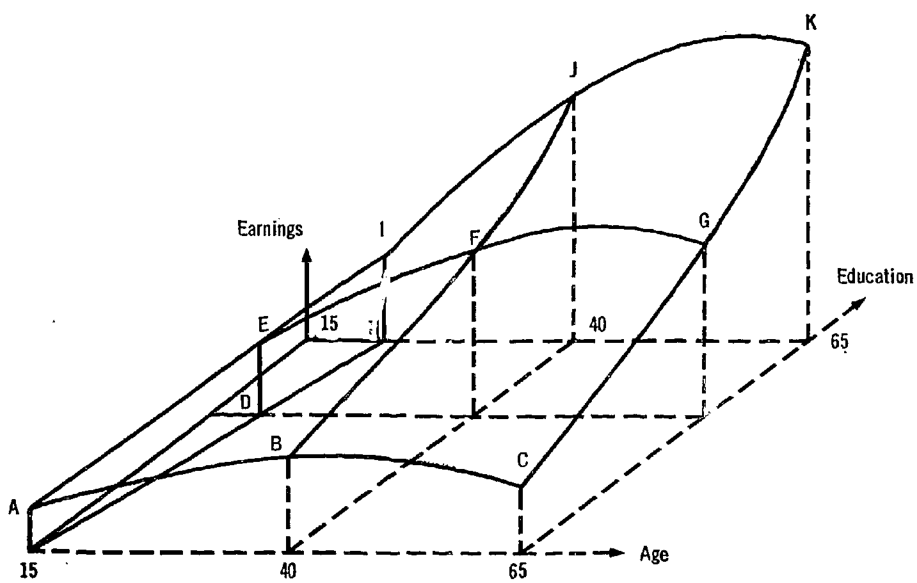
(ii) Do the shapes of these profiles depend on education? Does education itself tend to become obsolete?

(iii) Do these profiles depend on the industry under consideration? (This point has not been much emphasized by investigation so far, but may be of major significance to the manpower planner, and may have considerable explanatory power in accounting for productivity variations between industries and between countries).

Available United States data suggest that these profiles typically resemble those in the following diagrams, although our own evidence presented in Section IV is not entirely in accord with this.

Figure 2

TYPICAL AGE-EDUCATION-EARNINGS GRAPH

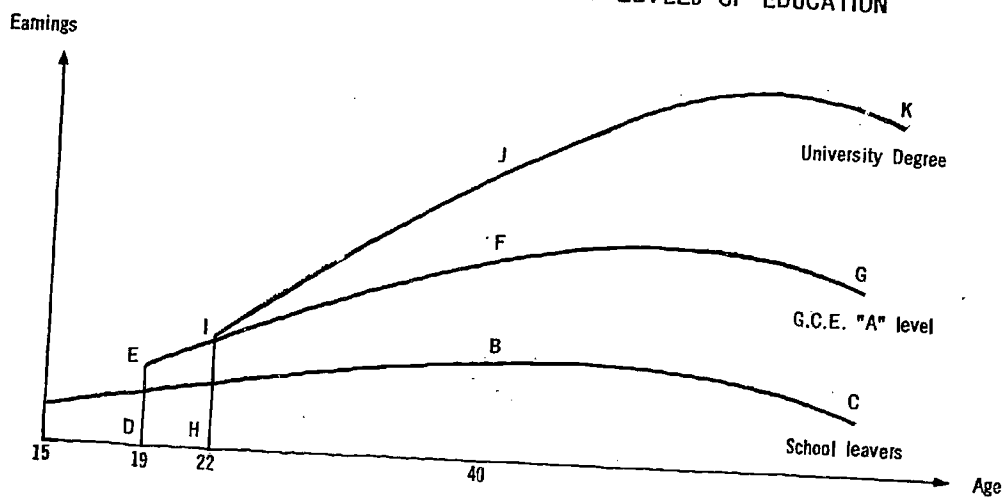


In figure 2, BFJ and CGK show the relationship between education and earnings at the ages of 40 and 65 respectively.

Since three-dimensional graphs are clumsy to work with, we collapse this diagram to two dimensions by foreshortening the third axis, measuring education.

Figure 3

TYPICAL AGE-EARNINGS PROFILE BY LEVELS OF EDUCATION



The diagrams are, of course, illustrative, as far as the United Kingdom is concerned, indicating the sort of relationships one would expect to discover from longitudinal data on the earnings of people with different amounts of education. By themselves, these profiles prove nothing about the economic value of education. It may be that the better educated start at higher salaries only because of social conventions in hiring policies ("conspicuous consumption" of education, some writers have called it); university graduates may have steeper profiles than school leavers simply because they are more able, and, hence, tend to rise faster in the occupational hierarchy; similarly, they may reach their peak earnings at a later age than school-leavers because they shift into executive positions from which they are hard to budge even after their efficiency has begun to wane. Negative explanations of this sort can never be decisively refuted by age-earning profiles, however carefully collected and extensive in coverage. On the other hand, confidence, in these ad hoc interpretations is considerably weakened by empirical evidence of well-behaved age-education-earnings profiles. The simplest explanation of the higher starting salaries of the educated is that they are generally more able and more motivated, profit quickly from training, adapt themselves rapidly to changing circumstances, act with initiative in problem-solving situations, easily assume supervisory responsibilities: in short, they are more productive than the less educated, even when their education has taught them no specific skills. For all these reasons, they

may not only start higher, but may also rise faster with age and suffer less from obsolescence of knowledge and skills.

American census data on age-education-earnings profiles measures education in terms of school years attended, without distinction between types of school or major subjects studied. This may not be a serious matter, since the general pattern of American academic and technical education courses is fairly uniform. In particular, the large variety of part-time educational courses leading to formal qualifications that characterize the British educational system does not seem to be a factor of importance in the United States. But in the United Kingdom, there are literally dozens of different ways in which a student can continue his education after the school-leaving age, many of these involving formal part-time study at college contemporaneous with employment. Indeed the major technicians' qualifications and certain professional ones, such as those of accountants and solicitors, are generally gained in this way. For this reason we have directed our attention to educational qualifications held by a firm's labour force rather than to years of formal schooling received.

One interesting question that arises is whether all these different channels and types of further and higher education lead to fairly stable career patterns, in which those that are more or better educated consistently earn more at every age than those with less or worse education? As has been remarked earlier, one of the subsidiary objects of our study is to clarify the economic value of extra education in the British context by analysing the age-earnings profiles of large numbers of individuals employed in British industry, having received different amounts and types of education and training. In this way, we hope to demonstrate the value that employers place upon different educational qualifications. It is also an interesting question, but not strictly germane to the present study, to ask why Britain differs so strikingly from the United States with regard to the complexity of the education and qualification structure. Does this have some kind of functional economic significance, or is it a purely arbitrary fact of British history?

Relating all this to manpower planning involves us in two further difficulties. The first concerns the problem of extrapolating existing earnings differentials into the future. Even with no change in policy, and assuming that these averages are reasonable approximations to the relevant marginal magnitudes at present, the increases in the supply of various kinds of educated personnel are such that they may be a long way from the relevant marginal magnitudes in the future. Moreover, if educational policy is itself adapted to rates of return derived from these cross-sectional age-earnings profiles, a fortiori the earnings differentials relating to certain levels of education are likely to diminish. This tendency to overstate relative lifetime earnings, however, appears to be offset by the phenomenon of supply creating its own demand; the more university graduates are available, the more jobs are upgrated so as to require a university degree. In this way, the earnings differentials between secondary school and university graduates may be preserved and, indeed, historical data for the United States suggests no narrowing of earnings differentials between high school and college graduates since 1939 (1).

(1) H.P. Miller: "Income in Relation to Education", in "American Economic Review", December 1960, pp. 967-969

Unfortunately, this solves one problem by creating a second. Competitive upgrading of jobs in terms of required education throws doubts on the value of age-education-earnings profiles as reflecting the economic benefits of additional education. Employers may simply regard a paper qualification as a cheap indication of inherent ability and achievement-drive, reasoning that, say, an Arts graduate must make a better salesman than a man who has never met the challenge of higher education. The Arts graduate gets the better job and the better pay, not because higher education has improved his skill, but simply because the degree identifies him as the better man. To be sure, this argument loses force when we look at technical education: the flexibility which a broad scientific and technical training provides is very likely to enhance the potential productivity of an engineer. Even with a more academic education, the evidence suggesting that better educated people make better trainees, argues in the opposite direction. Nevertheless, this should remind us once again of the difficulty of demonstrating conclusively from data about earnings that extra education adds significantly to the productivity of individuals. Education may add to the productivity of firms by being a good indication of individual ability and drive, without adding to the productivity of individuals.

The tendency to raise the minimal educational requirements of jobs as the available labour force becomes more highly educated is sometimes cited as evidence of "conspicuous consumption" of educated manpower for reasons of prestige. While there may be an element of this, other explanations are also available. The most obvious is that it may merely be the consequence of a growth in the general demand for education as a consumer good. In this case an increased educational requirement may be necessary in order for a firm to gain access to individuals of the same level of ability as before. Secondly, the jobs themselves may be upgrated and extended while retaining the same titles and simple description. Thirdly, the value of education may be more apparent to the educated so that the process becomes a self sustaining one. The "conspicuous consumption" hypothesis is in practice extremely difficult to test. It would be necessary to discover cases in which some firms persistently made less profits or produced less output than others in similar conditions except for employing more highly educated personnel. Without more precise information about the correct level of education required by firms, it is not easy to identify firms employing excessively-educated personnel.

Another problem worth raising now concerns on-the-job training and vocational training. The average individual is promoted at various stages in his working life to better-paying jobs for which he qualifies either by experience acquired in the last job, or by attending a training course off-the-job, or by informal on-the-job training. Formal training courses are, we know, a standard method in industry of promoting men to new positions, and although there are few figures about on-the-job training, casual impression suggests that it is no less important. The question that is relevant to the interpretation of age-earnings profiles is this: who actually pays for these training schemes?

Becker, working with the model of a perfectly competitive firm, distinguishes between "specific training", which increases the marginal productivity of a worker in the firm providing it more than in other firms,

from "general training" which raises the worker's productivity equally in any firm (1). Presumably, all training has a specific and a general element. In addition, through the working of competitive markets what was previously specific may become general and vice-versa. Monopoly and restrictive practices make the general specific; competitive entry makes the specific general. Since, under competitive conditions, wage rates are determined by the worker's marginal productivity in any firm whatever, firms have no incentive to pay the costs of "perfectly general training"; hence, the initial cost of such training is passed on to the trainees in the form of reduced earnings during the training period (formal education is, of course, one example of "general training"). Only to the extent that on-the-job training is "specific" to a firm (say,formal orientation programmes, initial rotation among departments, etc.), will the firm have to bear the burden of training expenses (2). Thus, the upshot of Becker's argument is that most training is, in fact, paid for by the trainees themselves.

As soon as one applies this kind of reasoning to actual training phenomena, one runs into problems. Firstly, there is the extraordinary variety of training schemes that seems to defy measurement in any quantitative way. The obvious common denominator, money costs, is intrinsically difficult to measure, and few firms attempt to keep adequate accounts of training expenses. As far as managerial positions are concerned, the most important aspect of general training is experience and it seems impossible to identify the cost of giving a manager experience. Moreover, whenever on-the-job training is a joint input with machinery in a particular investment project, as with retraining schemes preparatory to the expansion of capacity or the installation of new labour-saving devices, there are no identifiable training costs that can be shifted to trainees (3). Nor is it an easy matter to test Becker's argument directly by comparing the earnings of similarly educated men of the same age who do and who do not receive training; as we have seen, many aspects of training, such as the opportunity of gaining experience by senior staff or, for those in more junior positions, of learning on-the-job by watching a more skilled worker, seem extraordinarily difficult to measure and few firms attempt to keep relevant records of this. Furthermore, the possibility that firms use their training schemes as fringe benefits for recruitment purposes, or as a device for reducing labour turnover, or simply as a status symbol, complicates the interpretation of any finding about earnings vis-a-vis training received.

Be that as it may, if training is a substitute for formal education, as is so often alleged, the less educated would receive the bulk of the training that is provided. On the assumption that this training is largely what Becker calls "general training", it is conceivable that the workers themselves pay for it in the form of reduced starting wages. This serves as a simple explanation of why the age-earnings profiles of the less

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(1) E.S. Becker: "Human Capital", N.Y. Princeton University Press, 1964.

(2) Becker, op. cit., pp. 8-29.

(3) As R.S. Eckaus pointed out in objecting to Becker's analysis "Investment in Human Capital: A Comment", in "Journal of Political Economy", October, 1963.

educated generally lie below those of the more educated. But in that case we would expect the profiles of the less educated to rise more steeply and possibly to cross the profiles of the more educated at some later stage, as the fruits of their training became manifest. This seems to happen to a certain extent, but not enough to confirm this hypothesis. Contrariwise, if "general training" is complementary to formal education, as we suggested earlier, the more educated would have their starting salaries artificially reduced by the cost of training; without training, they would start at even higher levels. Subsequently, their age-earnings profiles would rise more quickly than that of the less educated. This too is borne out to a certain extent in practice. Thus, in the light of the evidence of age-earnings profiles, it is difficult to justify either assumption complementary or substitutability, as the correct one.

All these considerations would not affect the estimating of lifetime age-earnings profiles from cross-sectional data if only the incidence of training in industry had remained fairly constant over time. But there is ample evidence that British industry has moved steadily away from the reliance on contractual apprenticeship training to more and more formal training classes within factories, and increased attention to informal on-the-job training. Therefore, if training has any effect on earnings, the effect must have registered more sharply on recent post-war earnings than on pre-war earnings; thus, the future earnings of the graduates of today may be much higher than one would anticipate from looking at the earnings of graduates now aged 45.

It is quite clear that if we are to take age-education-earnings profiles seriously, we must not be satisfied with a crude index of the formal schooling received by a firm's labour force, as a measure of its educational input. Rather, we must make an effort to collect data on the training of workers, avoiding the fallacy of measuring educational inputs by a scalar. In fact, a vector of five components - amount of formal education, paper qualification, type of formal education, amount of labour training, and type of labour training - is probably required to do justice to the concept of the education-intensity of a firm.

This introductory section may be concluded by relating the ideas presented in it to some of the traditional notions concerning business operations usually put forward by economists. Typically, the economist has treated the firm as hiring one or two durable inputs (land and capital) and one non-durable input (labour). The former involves, as it were, overhead costs; the latter does not. In either case set-up and dismantling costs tend to be neglected as do the costs of purchasing and selling. More recently economists have begun to realise that such a model does not account satisfactorily for what is observed in the real world; the research which we have undertaken lends support to the new view.

The first new idea of importance is that capital and labour must not be distinguished so sharply from one another. This is obvious from the point of view of the individual; it is also true from the point of view of the firm. The firm makes an investment in its labour force in much the same way as it makes an investment in its physical capital. The labour force is trained formally and informally for the productive purposes of the firm and also becomes more adapted to the operations of the firm by the accumulation of relevant experience. Labour costs, therefore, become in many ways fixed costs, and this process is presumably increasing

over time. It follows that the firm is just as likely to want its trained labour to leave it as it is to give away its machinery. If this is the case, the firm will need to plan its use of labour over time in much the same way as it plans its use of capital. Apart from the point that training itself takes time, it is also necessary (in order to calculate profitability) to look far enough ahead to determine what jobs the trained man will do and for how long. This is accentuated as the labour force itself increasingly insists on, and gets, longer terms of contractual service.

A second new idea which is related to the first one is that there are significant costs involved in the "purchase" and "sale" of labour. These costs increase, possibly disproportionately, with the increased educational level of the labour force. These purchase costs are, in part, what our research has been about: to determine the right man and his qualifications for the right job. The sales costs also must not be neglected. They consist in part of assessing how the man is performing and deciding on his future; and in part of assessing any loss of morale by others and the affect on hiring policy of letting him go too abruptly. More generally, hiring labour is not simply a matter of going to a market and purchasing a homogenous product off the shelf which may be discarded as soon as it is not wanted. It is much more a process of expert selection of a highly heterogeneous product which, once acquired, involves a commitment for expenditure over time and the need to make it "work".

The third new idea again involves blurring a distinction which economists have been used to making between the production and consumption activities of the worker. It is doubtful if this distinction is or has been entirely valid for the most unskilled, least educated labourer; it is certainly not valid for the highly skilled, educated employee. Essentially, job satisfaction and attitudes to the firm become part of the individual's consumption pattern. The commitment by the firm to him is counter-balanced by his commitment to the firm. He has a career in mind, and labour turnover involves him in high costs. Moreover, he invests in the firm by adapting to it and accumulating the experience it requires, just as much as the firm invests in him.

From all this emerges the dynamic approach to the individual employee in terms of a progressive career pattern with the firm, the need to optimise with respect to the individual rather than hire him or fire him at will, and the conversion of an increasing share of labour costs to overhead costs or fixed costs. That this is so does not, of course, mean that at the present time firms have fully recognized the new phenomena confronting them or are behaving optimally with respect to them. Quite the contrary, we have found that most firms have not explicitly recognized the need for a policy of conscious manpower planning over time. They are to a large extent in the unenviable position of realising that something is wrong, that the world is becoming increasingly complex and that they must adapt to it, but not knowing precisely what to do. Thus, as has been remarked already, firms do not keep appropriate records of their labour force, and make insufficient use of those they do collect. At the same time the personnel function tends to be undervalued comp[illegible]ith other functions such as design, production, sales or finance. It is the last section to be modernised, so to speak. Firms find themselves in the contradictory position of acquiring the latest equipment which they try to optimise within the context of an out of date

labour force policy. They then try to adapt the latter simply by going into the market to buy more educated and trained personnel. If, however, both machine and labour policy are part of capital investment policy as a whole, they must be dealt with jointly in a fully integrated pattern. A chief conclusion of our research is to emphasize this necessity and to see manpower planning as a first step in that direction.

II. The case for interfirm analysis

There are in principle at least three possible ways of investigating the optimum educational requirement for specific occupations: (i) detailed analysis of the functional content of particular jobs related to one or more measures of the worker's job performance; (ii) interview surveys of employer opinions about the 'minimal' and 'optimal' levels and types of preparation required for efficient job performance, and (iii) international comparisons of the distribution of occupational categories by educational attainment (1). After a brief discussion of these three alternative approaches, Parnes has concluded:

> "Irrespective of the method used to adequate occupations with required educational qualifications, most of the categories in the occupational classification system will be associated with a range of educational preparations rather than a single educational background. As has been mentioned earlier, this is so for at least three reasons. In the first place, many of the occupational categories are quite broad, and include occupations with varying levels of skills (e.g. clerical workers; administrative, executive and managerial workers). Secondly, even specific occupational titles (e.g. secretary, engineering technician) comprise jobs of varying complexity that require different levels of competence. Finally, there are differences of opinion as to the optimum combination of general education, vocational training and work experience even for a very specifically defined complex of functions".

There is, moreover, a fourth reason for the apparently loose connection between occupation and education, related to Parnes' first one, namely, the crudity of definition of the occupational categories themselves and the variety of interpretations placed upon them by different firms in different industries. The unexamined assumption in most of the literature on manpower planning is the stability of occupational classifications, if not across, then certainly within the various sectors of the economy. The complaint is that all countries lack data on the labour force cross-classified by occupation as well as by all types of education and training, but the validity of the occupation census itself is rarely questioned.

(1) Parnes, H.S: "Forecasting Educational Needs for Economic and Social Development", pp. 39-41. OECD, Paris, 1962.

It may be doubted, however, whether the census concept of occupations is sufficiently well-defined to be useable as a research variable. At any rate, it should not be assumed to say the least that an analysis of the job content of a particular occupation in one industry would constitute an adequate basis for generalization about all similarly titled occupations in other industries. Indeed, the same argument may well be applied to individual firms within a given industry. Before enquiring into the optimum educational level for specific occupations, one must ask the deeper question: why is the occupational structure what it is? The obvious answer, because a certain product is being turned out, is relevant but not sufficient as we know that firms within an industry vary widely in the character of the technical processes they have adopted to produce an identical output (1). When the best and worst practice technique differ radically from the average practice technique in the industry - and this is the common case - surely, there must be correspondingly wide variations in the occupational structures of different firms in the same industry. This argument suggests that we must relate the educational qualifications of personnel not simply to the functional content of the jobs they are holding, but also to the economic performance of the entire enterprise, as indicated by its size, share of the market, rate of growth profitability, financial structure, capital intensity, technical dynamism, and managerial organization. In short, we must look at the connection between the education-intensity of a firm and its economic efficiency as a productive unit. Given a satisfactory occupational classification, except in the simplest possible cases, optimality still requires some consideration being taken of costs and benefits. The practical question is not so much "Is this much education necessary for this occupation?" but more "Is the extra productivity of additional education for this occupation worth more than the extra cost?" In addition, it is necessary to distinguish social costs and benefits from private ones, either as viewed by the firm or the individual employee. In countries where education and training are entirely or mainly financed by taxation, the allocation of education to occupations may reflect individual consumer preferences rather than national productivity requirements unless there is public manpower planning.

To study this and related questions at the level of the industry instead of the firm is to remain, so to speak, two steps removed from its actual solution. There is considerable scope for further research in the area of job analysis and job evaluation but, in the nature of the case, this cannot account for interfirm variations in the structure of occupations. Similarly, the results of opinion surveys of employers, while of limited value, can at best tell us what they think they are doing, not what they actually do. Furthermore, while many, if not most, employers hold views on the utilization of educated manpower, as a recent Ministry of Labour survey of the metal industry revealed, very few of them engage in deliberate manpower planning (2).

(1) See W.E.G. Salter: "Productivity and Technical Change", London: Cambridge University Press, 1960, pp. 23-26.

(2) According to the British Ministry of Labour: "The Metal Industries, A Study of Occupational Trends in the Metal Manufacturing and Metal Using Industries", London; HMSO, 1963, p. 20 only one out of four British metal firms takes a systematic forward look at their manpower needs.

Here, as elsewhere in economics, the more fruitful, and certainly the more operational approach is that of analyzing the "revealed preferences" of employers. By measuring the educational characteristics of a firm's labour force, including on-the-job training, for systematic comparison with quantitative indicators of the firm's economic performance over time, it is possible to ask such questions as: (i) within the same industry are there significant interfirm differences in educational inputs; (ii) are such differences associated with differences in the size of firms, their rates of expansion, their profitability, their capital intensity, the level of techniques adopted, or some combination of all these; (iii) contrariwise, is it true, as one American investigation alleged, that "the rate of innovation in interprises governs the rate of increase in the utilization of skilled personnel of all kinds" (1), or, with equal likelihood, that the most important influence is the quality of senior management? The implications for manpower planning of statistically meaningful answers to such questions should be obvious. An affirmative answer to (i) would imply that manpower forecasting cannot be accurately carried out at the sectoral or industry-level, but must pay attention to the distribution of firms within an industry. The answers to (ii) and (iii) would indicate just which aspect of interfirm variation would have to be taken into account. In this way, a much firmer basis would be provided for predicting the manpower patterns implied by different growth targets. Along the way, associated problems such as whether training is a substitute for or a complement to formal education, and whether it is "general", "specific", or a joint product with output would necessarily be illuminated, if not decisively solved, with consequently practical implications for manpower policies.

The essence then of the micro-economic interfirm analysis, which is the basis of the research being carried out in the Industry Project, is the need and desirability of examining precisely what individual firms do and why they do it. It enables us both to correlate variables of individual economic performance with the occupation and education of the firm's labour force, and to see more clearly the firm's environment for action and how its decision-making actually takes place. We come to understand the firm partly as it sees itself, so to speak, and are enabled to comprehend its operations in connection with manpower in a deeper sense than would be the case if we restricted ourselves solely to econometric models.

III. The pilot studies

The pilot studies took place, intermittently, during the period June 1964 - June 1965. Although much of the discussion on this paper, as well as the data presented in Sections IV, VI and VII relate to only

(1) This is the principal conclusion of S.E. Hill and F.H. Harbison: "Manpower and Innovation in American Industry", Princeton, N.J.: Princeton University Press, 1959. A study of fifty large American companies.

five firms, it should be borne in mind that some fifteen firms were contacted for pilot studies, in most cases involving detailed inspection of personnel records, factory tours and long discussions with high level management. Thus it would be true to say that the thoughts expressed in this paper are supported by far more evidence than is displayed for the five pilot-studies alone.

Table 1 gives a synoptic description of the five firms selected for intensive investigation; for obvious reasons, the identity of these firms is withheld. In view of the difficulties encountered in gaining entry to firms, it must also be emphasized that it was not always possible to select representative firms for the pilot studies. However, certain basic factors did weigh in the final selection of the firm. In view of our concentration on the electrical engineering industry, only firms within this industry were chosen, with the exception of Firm 3 in the motor industry, which was included to assist an inter-industry comparison. Within the electrical engineering industry, we chose firms of differing size, with due attention to the range of products produced by different firms in the industry. Finally, we excluded any firm that felt unable to make available the full range of personnel data, with the possible exception of information relating to the highest echelons of the labour force.

We did not always study all sections of the firm selected for investigation. For Firms 1 and 5 our attention was directed to the one location that housed the organization selected for study. In Firms [illegible] 3 and 4, however, the organization consisted of a headquarters and a number of widely dispersed factories and sales/distribution centres. Partly because of this dispersion, and partly to save time in what were only piloting studies, we confined our detailed investigations and particularly our personnel data collection to headquarters and the one factory located at the headquarters site, on the assumption that this onsite factory was typical of the others. This is not always the case and the disadvantage of our procedure was to deny ourselves the opportunity of comparing two factories where many, but not all, conditions were similar; for example, we might usefully have investigated the effects of geographical location and the age of a factory on the utilization of educated manpower within a firm.

It will be seen from the table that there is considerable variation in the status of the organizations studied, although in this paper they are all loosely referred to as "firms" for convenience. At an early stage of our work, a decision had to be made regarding the level within a firm's organizational hierarchy at which to locate a pilot-study. Personnel records containing the range of occupational, educational and salary information required for our study tend to be maintained at the plan or establishment level. On the other hand, economic information tends to be kept centrally and in highly aggregated form, with little breakdown available relating to various parts of the firm. With these conflicting considerations in mind, we decided to select for study the lowest level in the firm's organization that is financially self-accountable and, therefore, able to supply economic information relating to its own activities. In the case of a small company, this procedure might mean investigating the firm as a whole (Firm 4). But in the case of very large firms, and particularly in more recent years, there is generally a considerable degree of decentralization of financial responsibility. This can take a number of forms. Some companies will achieve decentralization by splitting off sections of

the firm into wholly (or partly) owned subsidiaries (Firm 2); in other cases, there is a geographical or, more frequently, a product-group basis for devolving responsibility to separate profit centres (Firms 5 and 3 respectively). The organizational differences between firms shown in Table 1 should be viewed in this context.

For the piloting stage, this method of approach enabled us to keep in close proximity to the sources of detailed personnel data as well as enabling us to acquire various items of economic information relating to the whole of the "sub-firm" that was being studied. Nevertheless, there are a number of problems associated with this procedure which raise questions concerning its adoption in the large-scale study. In studying only a part of a firm (albeit one that is relatively autonomous) the influence on its operations of higher-tier general management and expertize is excluded from the scope of the study; yet in an investigation on the effect on economic performance of educational resources available to firms, these might be expected to be crucial explanatory factors. In particular indivisibilities may confine the provision of specialist skills, research departments and high level management services to the central organization of large firms only, but with the benefits of this centralized expertize being available to lower levels of the organization. In theory it might be possible to apportion to the various decentralized sections of the firm some part of the overhead cost of providing such centralized services as the use of computational facilities and research laboratories. In practice, however, the precise benefits resulting from inclusion within a large organization will be elusive and extremely difficult to quantify; in particular, this inhibits meaningful comparisons with single or near single product firms.

Apart from the question of apportioning such overhead costs as those of highly qualified personnel and specialized service departments, there is a further problem encountered in treating these sub-firms as autonomous units: this concerns the usefulness of economic data relating to the sub-firm alone. It is probable that the economic performance of the subfirm cannot be sensibly appraised independently of that for the firm as a whole. The activities of the various groups within a large firm are frequently inter-dependent and this raises the problem of whether the valuation of services performed by one group for another is at economic costs, and whether these are marginal or average costs. An example is provided by the sub-firm referred to as Firm 3: here, the total car body output of the division is tranferred to a second autonomous sub-firm, the body assembly division. In a similar way, Firm 2 buys in considerable quantities of components from a partially-owned subsidiary company. In the former case transfer is at cost only; in the latter it is unclear whether these components are bought in at market rates, at cost, or at shadow prices arrived at in some other way. Problems of this kind bring into question the reliability of data relating to the turnover, value added and profitability of these "sub-firms".

In the large inter-firm study these problems concerning the relationship between sub-firms and parent firms cannot simply be by-passed by selecting the firm, as such, as the unit for study. This is so for a number of reasons. First, problems will remain of a similar nature to those discussed above relating to the sub-firm. These derive from the considerable interaction of financial interests between companies that

Table 1

The pilot study firms

Firm	Status of organisation	Location	Products	Main production process	Product market	Sample size of labour force (unweighted)
1	Product divisions of major electrical engineering company	Midlands	Mainly heavy electrical engineering machinery, but some light electrical engineering products	Ranging from one-off to large batch	Industrial/ Government	1,316
2	*Wholly owned* subsidiary company	London area	Lamps	*Continuous* mechanical flow.	Consumer/ industrial	677
3	Product stage division of car manufacturer	S. England	Car bodies	Mass	Consumer	715
4	Parent company	London	Electric power tools	Mainly small batch	Consumer/ industrial	339
5	Wholly owned subsidiary of a wholly owned subsidiary company	London	Data processing equipment	Small batch	Industrial	94

exist in the United Kingdom today, and which frequently make it extremely difficult to define the limits of a firm. Holding companies; minority interest in other firms; wholly-owned subsidiaries at home or abroad: these are but a few examples of the financial inter-relationships betwee firms, the full ramifications of which are extremely complicated and difficult to disentagle. Some of the largest companies in the United Kingdom are jointly-owned subsidiaries of other companies - would these be treated as separate firms in our study? To take the two points discussed earlier: it cannot be assumed that there is no seepage through of expertize and entrepreneurial talent from the parent companies, nor is it clear that the available economic information relating to these subsidiaries is fully meaningful. For example, what is the basis of the prices charged when a subsidsidiary company buys from or sells to a parent or otherwise associated company? Or with regard to the availability of capital, do wholly-owned subsidiary firms borrow from the parent companies at market rates and what determines the size of dividend paid? These are questions which have received surprisingly little attention in the literature; the problems to which they give rise will have to be faced in defining our unit of study for the major study.

There is a more telling reason suggesting that the firm as a whole would not be a suitable unit for investigation in the major study. This relates to the need for homogeneity in our sample.. A major reason for concentrating the study in one industry has been the recognition that the scope and pattern of educational manpower usage in a firm is likely to differ from industry to industry according to the state of technology, average size, rate of growth of firms, and other relevant factors. But further investigation has shown that even within an industry (and particularly one as heteregeneous as the electrical engineering industry) differences between firms in these respects may be very marked indeed. To a large extent these inter-firm differences reflect the nature of the firm's product, which is one of the major influences determining qualified manpower utilization; this is because different products are associated both with different productive techniques and different marked situations. Consequently, a random survey of the whole electrical engineering industry would encounter too much product heterogeneity to establish meaningful relationships; this suggests that it may be advisable to limit our survey to six-eight homogeneous product groupings, which cover between them the different production techniques and market situations which seem likely to affect manpower utilization. Since most firms are multi-product enterprises, the requirement of product homogeneity must mean that most of the units in our sample will consist not of whole firms, but rather of those parts of a firm that produce within a limited number of product groupings. Only in the case of certain specialist producers would the firm as a whole constitute the unit of study.

So much for our present thoughts on the unit of investigation in the inter-firm study. We now consider the range of data that we attempted to collect from the five pilot firms, and which ideally would be collected from each firm in the larger survey; this is listed below. Generally speaking, we obtained information at two levels: that relating to individual members of the firm's labour force [Items (i) and (ii)] and that relating to the activities of the firm as a whole [Items (iii - vi)].

(i) Occupational structure of the labour force classified by broad functional groupings, including job titles and job descriptions where available, sex, age, years of employment in firm, and salary of each member of the labour force.

(ii) Education of each member of the labour force in terms of school leaving age, paper qualifications attained, part-time education attended, on-the-job training received, membership of scientific or professional institutions.

(iii) Measures of the size of the firm in terms of labour inputs (i.e. total number of employees and total salary bill), gross turnover, value added, and capital stock (i.e. capital asset figures revalued in terms of replacement cost).

(iv) Financial structure, including a measure of profitability, as derived from published balance sheets.

(v) The firm's organization and production methods.

(vi) The hiring policy of the firm, especially in relation to more qualified personnel.

Work on the pilot studies highlighted the range of difficulties, mainly of a practical nature, that must be faced in research of this type. We can distinguish three groups of practical problems that were encountered relating to: entry into the firms; their reluctance to disclose economic data, and the availability of personnel data.

We found that firms varied considerably in their responsiveness to an inquiry of this sort, and that a great deal of time can be consumed negotiating entry into a firm. Furthermore, veto possibilities exist all over the managerial hierarchy, and since the sources of the information required for our study range over many departments within a company, we sometimes found ourselves halted in the middle of a pilot-study by the necessity to take up negotiations all over again.

We were forcefully reminded, at various stages of the pilot work, of what has for long constituted the main obstacle to research at the firm level; the extreme reluctance of firms to disclose economic information relating to the firm as a whole, despite our undertaking to keep secret the identity of individual firms. Only one of the five pilot firms studied provided us with the full range of economic data requested despite favourable assurances at earlier stages. Unfortunately, there is no outside source for this economic data. Published balance sheet data do provide some economic information relating to public companies, but this is of only limited use. Although asset figures in published accounts have frequently been used to measure capital, one may doubt the reliability of this source. In the same way, published profit figures are frequently misleading since they include profits derived from transactions of a purely financial character, not related to the operating activities of the firm; usually, operating or trading profits are not shown in published accounts. In any case, as we have noted above, in the large-scale survey we shall be investigating divisions of firms or perhaps firms which themselves are parts of holding companies; for neither of these cases is balance sheet data likely to be published. Whilst economic information relating to sections of firms (establishments) is collected in the Census of Production,

including gross turnover and value added, the Board of Trade is forbidden by statute to disclose information on firms (or establishments) to anyone outside the government; in any case, the most recently available Census of Production relates to 1958.

Other economists have been faced with these difficulties in the past, but it is not at all clear why firms are so loath to make available economic information even on a strictly confidential basis. Presumably fears of possible identification in published accounts of the study, or of the disclosure of valuable information to competitors, perhaps inadvertently, seem to weigh heavily. But economists themselves have tended to argue that these fears are exaggerated, especially with respect to turnover, if not profits. Sometimes, firms give a blanck refusal to supply information on the grounds that "it is not the firm's policy" to disclose such information, unless there is a statutory obligation to do so. It must be remembered, however, that the pilot studies were conducted by an academic group without support from government departments. The larger survey will have the sponsorship of the Committee on Manpower Resources for Science and Technology, which it is hoped will not only ease the problem of entry but also increase the willingness of firms to supply economic information.

The pilot studies showed that firms generally do not keep their personnel records, and particularly information on the educational background of the labour force, in a form that would enable them to provide us with the sort of information we require. Furthermore, individual firms differ markedly in the availability and accessibility of their personnel data. A few firms have computerized their personnel records, but most firms do not keep their personnel data in one central place, and even when they do, they do not always classify them on a uniform basis, or keep them up to date. It proved to be a major research task, both time-consuming and arduous, to extract personnel data and to convert them into a useful form; to collect the relevant material from a firm relating to a sample of, say, 500 people, can absorb as much as twenty-five man-days, and this is preliminary to coding the data in preparation for analysis by computer. Greater practice in data collection is expected to reduce this time considerably. It is important to note that the shortage of useful personnel data in firms and the generally unsatisfactory condition in which it is kept, is a factor that has been given insufficient weight in the past in discussions of the usefulness and feasibility of manpower planning.

Generally speaking, firms have been prepared to allow the research team free access to all possible sources of relevant personnel data; the only striking exception is salary information about individual members of the labour force, even when in coded form. Reluctance to disclose the salaries of individuals constituted the most frequently met but not insuperable barrier to progress in the piloting phase of our study.

So much for general problems encountered. It is clear from the preceding discussion that very little was accomplished in the pilot studies in relation to economic information, and that the main attention of the research team was directed towards examining the problems involved in collecting personnel data from firms. Apart from this general piloting work in the five firms, much of our attention was directed to the task of collecting comprehensive personnel data relating to individual members

of the labour force in these firms; such an exercise is a necessary preliminary to compiling figures of education attained. In particular, extensive data on the education, age and salary of a large sample of individuals from the five firms were collected. The results of a preliminary analysis of this data are presented in the following section; but we conclude this section with a discussion of the availability of detailed personnel data within firms.

In the absence of fully computerized personnel records including educational information, it is necessary to use one or more of the following data sources: original application forms in dossiers; personnel cards; information supplied by heads of departments, and questionnaire surveys of individuals. In addition, it is usually necessary to go to the firm's Cashier for salary data and to the Training Department for details of the extent of on-the-job training and day-release within the firm. A number of considerations, apart from availability of data, governed the decision to use one or another source of data.

From the team's point of view, as well as that of the firm, it was essential to complete a pilot-study within a firm as quickly as possible; in some cases, it was necessary to guarantee to complete the pilot-study within a stipulated time period as a condition of entry to the firm. A related point is the need to avoid disrupting the normal flow of work in the firm and as far as possible to restrict research activities to the personnel department. It is clear that some data-collecting methods are more likely to produce data-transmission errors than others. Errors may arise from the sampling procedure adopted and finally, some data sources are likely to be out of date and, in particular, not to contain details of part-time education received since joining the firm. Given these considerations, the relative merits of the main sources of personnel data are discussed below:

Application forms/dossiers: Original application forms for employment are usually contained in dossiers together with other personal information relating to the individual in question. Dossiers are filed either alphabetically or according to department. The advantage of using this source is that, once started, the team is largely independent, and all disruption is confined to the personnel department. Thus, permission is more likely to be given for the study. However, there is some risk of error. Errors in the application form may result from a tendency for the applicant to upgrade his qualifications, from insufficient space in the questionnaire, as well as from the absence of any qualification gained since the form was completed. These last two deficiencies are occasionally made good by other documents in the dossier, such as College reports. The main disadvantage of this method is that it is very time consuming and awkward to operate.

Personnel Cards: These suffer from much the same advantages and disadvantages as the Application Forms, although in many cases educational information contained in the dossier is not entered on the cards, and, when it is, the information is generally derived from the application form, thus introducing new transcribing errors. It is possible that in a few cases extra information, e.g. recent educational qualification, which is not in the dossiers, may appear on the cards. Personnel cards, filed either alphabetically or by department, are virtually always available, but frequently do not contain any educational information.

Heads of Departments: Heads of departments often maintain files relating to individual members of their department. These very often contain relevant personal information; where some information is lacking, departmental heads may be able to obtain this information quickly from section leaders or even from the individual himself. Unfortunately, this method considerably increases the disruptive effect of research and may be very difficult to organize. The information gained is likely to be up to date and generally accurate, but may suffer from the subjective views of the head of department and from his possible lack of accurate information on some employees.

Questionnaires to individuals: This method has the largest disruptive effect, particularly in the production departments, and may be very difficult from the point of view of producing a good response. The information gained will probably be more accurate than from any other source and certainly more up to date, but the disadvantage is non-response.

Computer run-offs: The accuracy of this source when available depends on the quality of the original source of information (usually the original application form but occasionally a specially instituted survey of employees) and the extent to which any additional information has been added. The great advantage of this source is that it involves no further transcription errors, very little inconvenience to the company and a minimum of work for the research team.

Unfortunately, it is not always possible to check the extent of errors in personnel data being collected from these different sources. If one source has already been used, companies are reluctant to allow the use of a second, more disruptive source. But apart from transcribing errors, it does appear that a major lacuna is that educational attainment information is not kept up to date.

Finally, we present a catalogue of the major sources of the personnel data collected in the pilot studies. The reader not interested in these more detailed aspects may prefer to turn, at this point, to Section IV.

The main sou.ces of personnel data obtained in the pilot-studies were as follows:

Firm 1: A computer run-off of "technically graded staff" was used, that is, all people in the managerial, professional, and technical group but excluding the administrative and professional staff of non-technical departments. This was a 100 per cent sample of the group which formed the vast majority of qualified people; no information was obtained relating to weekly and hourly paid staff. The run-off excluded information on non-technical qualifications and particularly GCE (General Certificate of Education) qualifications.

Firm 2: Data were collected for the headquarters and the one on-site factory. In the factory, 100 per cent of staff and 50 per cent of skilled operatives were taken, the lists being drawn up on a departmental basis from personnel cards. Educational information, available only for those who had joined the company since the war, was obtained from application forms. In the headquarters, there were no departmental lists and

the alphabetically arranged personnel files could not be used to draw them up, as job title and department were not always stated. Instead, lists were drawn up with the help of the departmental managers, who also gave educational information; salary code sheets were also used, in which case the education information was obtained from the files. Since no full departmental listings existed, no rigorous sampling was possible.

Firm 3: Data were collected for the headquarters and the onsite factory of the division. Lists were drawn up from the personnel cards which were available in alphabetical order within departments; educational information was obtained from the original application forms for employment or from other documents in personnel dossiers, which were in the same order. A 100 per cent sample of all senior staff (grade 9 upwards), a 50 per cent sample of grade 8 staff, and a 33 per cent sample of junior staff, (in each of the grades 1-7) was taken. For the hourly paid a 10 per cent sample of skilled operatives and a 50 per cent sample of apprentices was taken. Information was obtained on everyone except the Divisional Manager.

Firm 4: with the exception of 5 out of 6 service branches and a small factory elsewhere, the whole firm was taken. Lists were drawn up from salary review sheets, arranged by department; educational information was obtained from personnel dossiers arranged departmentally for the office and works staff and alphabetically for the factory staff. Educational information on the monthly paid staff was obtained by personal questionnaire, since no records of their education were available; the response was 23 out of 26. A 100 per cent sample was taken of the monthly and weekly office staff and the montly factory and works staff; a 33 per cent sample of weekly factory and works staff by department was also taken.

Firm 5: Data were collected for the whole of the company. Details of monthly staff were taken from personnel dossiers. Although questionnaires were sent to the 13 monthly staff whose application forms contained no educational information, all refused to answer. Weekly staff lists were drawn up from salary review sheets. As the system of personnel filing was being changed, and as these applications forms contained no educational information, questionnaires were sent to all monthly staff; 40 out of 53 responded.

IV. Age-earnings profiles

The present section contains some preliminary findings derived from the personnel data collected from the pilot firms. Since only (parts of) five firms were studied, we have not been able to undertake any analyses based upon inter-firm comparisons; on the other hand information relating to the age, salary and education of a sample of over 3,000 individuals was collected from these firms, enabling us to draw up age-

earnings profiles for the various main educational levels. These are presented in this section; in Section VII we use this age-earnings-education data to compute present values of the life-time earnings streams associated with the various educational levels, and thence to produce tentative estimates of the profitability of investment in human capital, represented by education. Perhaps a major reason for the wealth of research into the economics of education in the United States has been the ready availability for a number of decades of census data relating the education of individuals in terms of years of full-time schooling, to their age and earnings. Such information has never been collected officially in this country and a major task of the present research project is to compile age-education-earnings data for a broad sample of individuals in industry. But even at this stage of our work, we have obtained sufficient information to draw up tentative age-earnings profiles relating to the United Kingdom. The only other data of this kind available for the United Kingdom are those provided by a random sample survey carried out in 1963 by Research Services Ltd. Information was obtained from some 6,000 heads of households, relating gross personal income to terminal education age, the age at which full-time education ended (1). Our information is more comprehensive, including as it does data on actual educational qualifications attained rather than simply years of schooling; this consideration seems particularly relevant in the context of an educational system which qualifies a technician only by part-time or day-release methods.

Detailed personnel information relating to a sample of 3,141 individuals was collected from the five pilot-firms (Table 2); the population sampled is not the same for each of the firms, the actual sample in each case being determined by the availability of data and the time-period specified for our work by the firm. In no case did we collect personnel data for semi-skilled and unskilled workers; information on skilled men was collected from Firms 2, 3 and 4 only. Otherwise, with the exception of Firm 1, personnel information was collected in each firm for the monthly paid MPT group (managerial, professional and technical workers) as well as for clerical and other n-manual weekly staff.

Data relating to females have not been included in the age-earning profile analyses that follow. It would not be legitimate to include males and females together in the same calculations, given the fact of unequal pay for men and women doing similar work. On the other hand, the small number of females in the sample rules out the possibility of undertaking separate calculations for females; indeed, such calculations would not be very useful since only one of the females in our sample is qualified beyond the level of the Ordinary National Certificate.

The total male sample was divided according to various levels of educational attainment (2). The breakdown is given in Table 3.

Within these broad educational levels, the sample was divided into five-year age groups and the mean annual salary (gross of income tax) for each age group was computed. These mean salaries are shown in

(1) The findings of this surveys are summarized in "New Society" 9th July 1964, p. 26.

(2) See the Appendix for an explanation of the educational classification.

Table 2: The sample, by firm

Firm	Scope of sample			Sample size		
	Managerial, Professional and Technical Group (monthly staff)	Clerical (and other non-manual weekly staff)	Skilled Workers	Male	Female	Total
1	Yes (1)	No	No	1,316	0	1,316
2	Yes	Yes	Yes	505	172	677
3	Yes	Yes	Yes	681	34	715
4	Yes	Yes	Yes	217	122	339
5	Yes	Yes	No	82	12	94
				2,801	340	3,141

(1) "Technically-graded staff" only, i.e. excluding certain of the administrative and professional staff of non-technical departments.

Table 3: The male sample by levels of educational attainment

Level of qualification	Actual number in sample	Weighted number (1)
0. None, Unknown or Other	1,388	2,902
1. Below GCE "O" - level	56	130
2. GCE "O" - level	142	255
3. ONC/GCE "A" - level	342	410
4. HNC	425	450
5. Ordinary Degree	288	308
6. Honours Degree	160	175
Total	2,801	4,630

(1) The weighted number of persons in each educational qualification level takes account of that part of the sample where the sample fraction was less than 100 per cent. Since personnel information was collected for all monthly staff, in which group are concentrated those personnel with highest qualifications, the difference between the actual and weighted number of personnel in educational levels 4, 5 and 6 is very small. A smaller sample fraction was taken for lower grades of weekly staff, containing personnel with lower levels of education; hence the larger differences between the actual and weighted number of personnel with lower qualifications.

Table 4

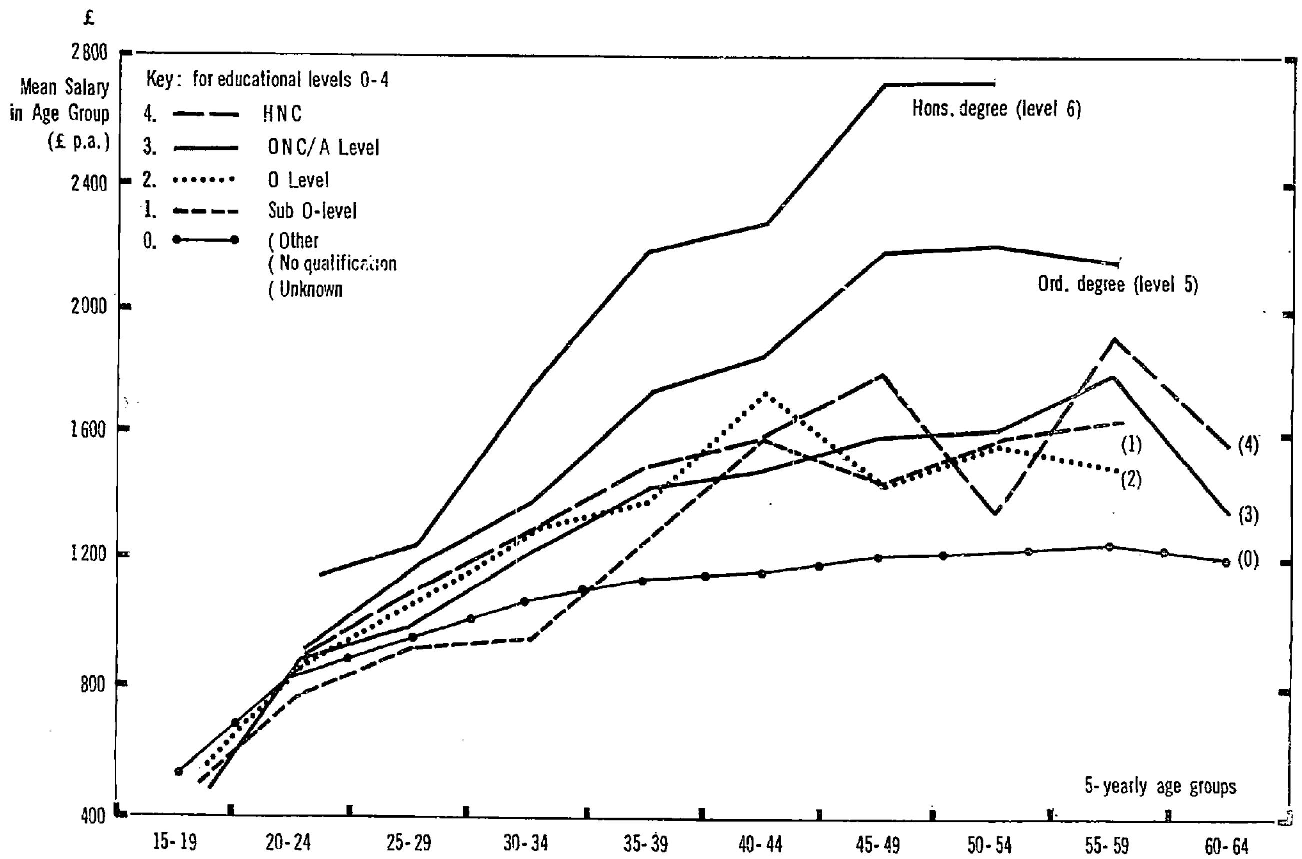
Mean annual salaries of males by age group and educational level

Age	Educational level													
	0		1		2		3		4		5		6	
	£ Mean salary	N° in sample	£ Mean salary	N° in sample	£ Mean salary	N° in sample	£ Mean salary	N° in sample	£ Mean salary	N° in sample	£ Mean salary	N° in sample	£ Mean salary	N° in sample
15	286		0	-	0	-	[illegible]	-	0	-	0	-	0	-
16	257		(308)	-	0	-	(308)	-	(308)	-	0	-	0	-
17	690	36	362		360		(360)	-	(360)	-	0	-	0	-
18	468		468	11	482	14	395	4	(435)	-	0	-	0	-
19	547		562		651		497		(540)	-	0	-	0	-
20	774		654		666		533		(650)	-	0	-	0	-
21	798		759		805		824		637		702		0	-
22	748	79	-	11	930	29	707	62	863	21	828		850	
23	902		885		785		896		841		991	42	1,081	14
24	934		742		903		972		1,059		980		1,217	
25–29	967	106	923	4	1,055	27	1,011	81	1,107	85	1,180	107	1,249	48
30–34	1,073	155	948	7	1,285	20	1,232	69	1,294	113	1,392	56	1,760	20
35–39	1,166	189	2,136	1	1,374	12	1,343	41	1,511	106	1,773	33	2,198	35
40–44	1,181	234	1,616	5	1,738	11	1,483	36	1,592	47	1,856	28	2,246	23
45–49	1,226	168	1,452	5	1,444	15	1,603	20	1,791	31	2,184	8	2,709	10
50–54	1,239	179	1,590	7	1,565	8	1,604	16	1,347	12	2,218	4	2,702	7
55–59	1,260	131	1,640	4	1,486	5	1,784	6	1,934	4	2,165	7	1,722	2
60–64	1,230	111	1,184	1	2,034	1	1,363	7	1,556	6	2,185	3	2,150	1

Note : Bracketed figures are estimated salaries based on apprenticeship rates.

Chart 1

AGE-EARNINGS PROFILES



Note: Level 6 (ages 55-65), 5 (ages 60-65), 2 (ages 60-65), and 1 (35-40 and 60-65) have been omitted.

Table 4. It is an inevitable result of collecting salary data on the basis of qualifications held that annual salary information relating to the holders of ONC and HNC is not picked up until they have achieved their qualifications. For this reason it is necessary to estimate the salary during their period of training on-the-job; the salary scales for apprentices in Firms 2 and 3 were used for this purpose. Table 4 shows the mean earnings of those aged 15-24 by successive years in order to indicate the rise in starting salaries for full-time employment that is associated with various educational qualifications.

The outstanding features of Table 4 are the consistent rise in salary with age and the close association of salary with educational attainment. A number of factors must be borne in mind in interpreting the data in this table. First, salaries in the upper range have been underreported, in the sense that salary information for senior executives was frequently not available, and in a few cases where it was feasible to estimate high-level executive salaries, our estimates were conservative(1). Secondly, the exact ages shown in the table for each education category at which full time education ends and earnings begin is arbitrary. Thirdly, it must be emphasized that unskilled and semi-skilled workers were not included in our sample; it is not clear precisely what effect this omission has on the mean salaries shown for the relevant education levels 0 and 1. Finally, education level 0 must be regarded as a miscellaneous category rather than one comprising individuals who left school at the legal leaving age; it includes individuals who have undertaken education beyond the school leaving age but failed to gain a qualification; it includes individuals whose qualifications we were unable to identify; it also includes individuals who may have achieved some further education that had not been entered into the firms' personnel records.

For each of the seven educational levels, we plot age-earnings profiles (Chart 1). Salary estimates for early years based on rates of pay for apprentices have not been included in the chart. We have also excluded the mean salaries for age groups with less than three observations. It will be noted that the profiles are upward sloping, reflecting the extra value of on-the-job training and experience. The slopes are closely related to the various educational levels; they level off for higher age groups, and for some profiles they eventually decline. Generally speaking, the profiles associated with the higher-level qualifications lie above those corresponding to the lower-level qualifications. Furthermore, the distance between some of the profiles widen with age. These caracteristics are particularly well developed for levels 5 and 6 (Honour degrees and Ordinary degrees respectively). The profile for level 4(HNC) lies consistently above that of level 3 (ONC/"A" level) except for the 50-54 age

(1) The effects of a combination of these two points can be seen in the mean salary contained in the box representing the 50-54 years age group and educational level 3. No actual salaries in excess of 3,000 p.a. were recorded although a number of salaries of up to £ 4,000 p.a. were estimated; it is very probable, however, that a number of individuals who were not included in the analysis or for whom salaries were estimated did, in fact, earn considerably higher salaries. We were able to estimate a salary in excess of £ 4,000 for only one individual, and the effect of including his estimated £ 6,000 salary in the appropriate age-education box was to raise the mean salary by over £ 200 p.a.

group, and there appears to be a tendency for the distance between these two profiles to widen with age, but this is not marked. The profiles corresponding to levels 1 and 2 are less well behaved, but this is not altogether unexpected in view of the greater possibility of sample error involved in these categories.

Although the profiles of the higher educational levels lie above the lower ones, there is some degree of interlocking of the profiles relating to educational levels 1, 2, 3 and 4 particularly for higher age groups. This may simply be due to the relatively small number of observations in our sample; a larger sample might be expected to produce smoother curves, which do not cross. On the other hand, if a tendency for these profiles to draw together and even to cross were to be confirmed in our more extensive investigations, this could be regarded as evidence that older people have managed eventually to overcome most of the economic disadvantages of being less educated. But the pattern could also reflect supply and demand factors applicable in the past but less significant for the future; in other words, older individuals were educated at a time when formal education was less readily available than at present and when firms, less impressed by the value of formal educational qualifications, were prepared to accept people with lower educational attainment and to train them on-the-job. The fact that profiles relating to university graduates lie consistently above the other profiles may reflect, as we noted earlier, either the superior value of higher-educated people or simply "conspicuous consumption" of graduates. The pronounced tendency for the distance to widen between the degree-level profiles and those relating to lower-level qualifications may be explained by the fact that firms provide more on-the-job training for higher-qualified individuals, or it may be due to the superior native ability of graduates making more rapid progress in the firm than those lacking university education.

More generally it is possible to interpret these age-earnings profiles in three different contexts: from the point of view of the individual, of society as a whole and of the firm. Relatively little attention seems to have been paid to the latter aspect; rather, discussion of age-education-earnings profiles has until now centred around the question of calculating private and social rates of return to education. The main reason for this emphasis is that age-earnings-education data relating to the labour force of particular firms hitherto has not been available; the main source of this data has been census and sample surveys of population, or special surveys of particular professional or other groups.

From the point of view of the firm, Chart 1 can be re-interpreted as illustrating a number of possible career paths of individuals over their working lives in a firm. These career paths pass through a series of horizontal salary bands representing the market values of successive job levels within the firm. In fact, we can conceive of an infinite number of routes which individual career paths may follow from the lower left-hand corner of the chart through a number of job levels to their ultimate job grade (or equivalent salary range) in the right-hand area.

We were interested to discover that Firm 1 had adopted a classificatory scheme for its technical and professional personnel which was similar to these career paths. The firm, a leading firm in the rapidly growing and highly competitive electrical engineering industry, was faced with the problem of achieving a balance between keeping down costs (including salaries) in order to remain competitive and of retaining high

quality personnel, on whom much of the success of the firm ultimately depended. By classifying personnel according to their potential worth to the firm and ensuring that their salaries always match their opportunity costs in the open market, the firm attempted to retain its most useful (and promising) personnel, without over-paying others.

Basic to the scheme is a careful distinction between the job an individual holds at the present time and the level of job the individual's ability and potential indicates him to be capable of holding ultimately. Each individual was given a salary progression grade, which related to his expected ultimate job level, as follows:

Ultimate grade as indicated by potential	Code Letters
Principal grade	L
Senior grade I	R
Senior grade II	M
Technician grade I - Upper	P
- Lower	N
Technician grade II	J

Those individuals accorded L, R or M grades were considered potential technologists (of various levels of seniority); those given P, N or J grades were considered as having a potential no higher than a technician. Market forces defined the speed at which a man might be expected to progress to his ultimate job in the firm, usually progressing through a number of more junior jobs.

Chart 2 illustrates the SPG system. The dotted lines on the chart indicate the levels of these job grades and their associated salaries; these bands are theoretically horizontal, but it is assumed in practice that a young man in a given job will need help in discharging his responsibilities in the early stages and hence is paid less than an older man. The chart also gives a number of salary progression curves, which trace the career path through which an individual may progress towards his ultimate job level. The particular progression curves shown represent the upper and lower limits of each salary progression grade. The actual progression line for a particular individual, within any given progression grade, may lie anywhere between these upper and lower boundaries.

The basic problem, of course, is how to gauge a man's potential. A point of particular interest was the fact that Firm 1 graded its personnel, initially, wholly by reference to the formal educational qualification held, although there was the formal possibility of a reappraisal of potential, if a man's job performance proved unsatisfactory. The grading scheme is illustrated below:

Ultimate grade indicated by potential	Code letter	Educational qualification
Principal grade	L	1st class honours degree.
Senior grade I	R	2nd class honours degree.
Senior grade II	M	Other graduates or graduate members of professional institutions.
Technician grade I - Upper	P	HND
II - Lower	N	HNC
Technician grade II	J	ONC

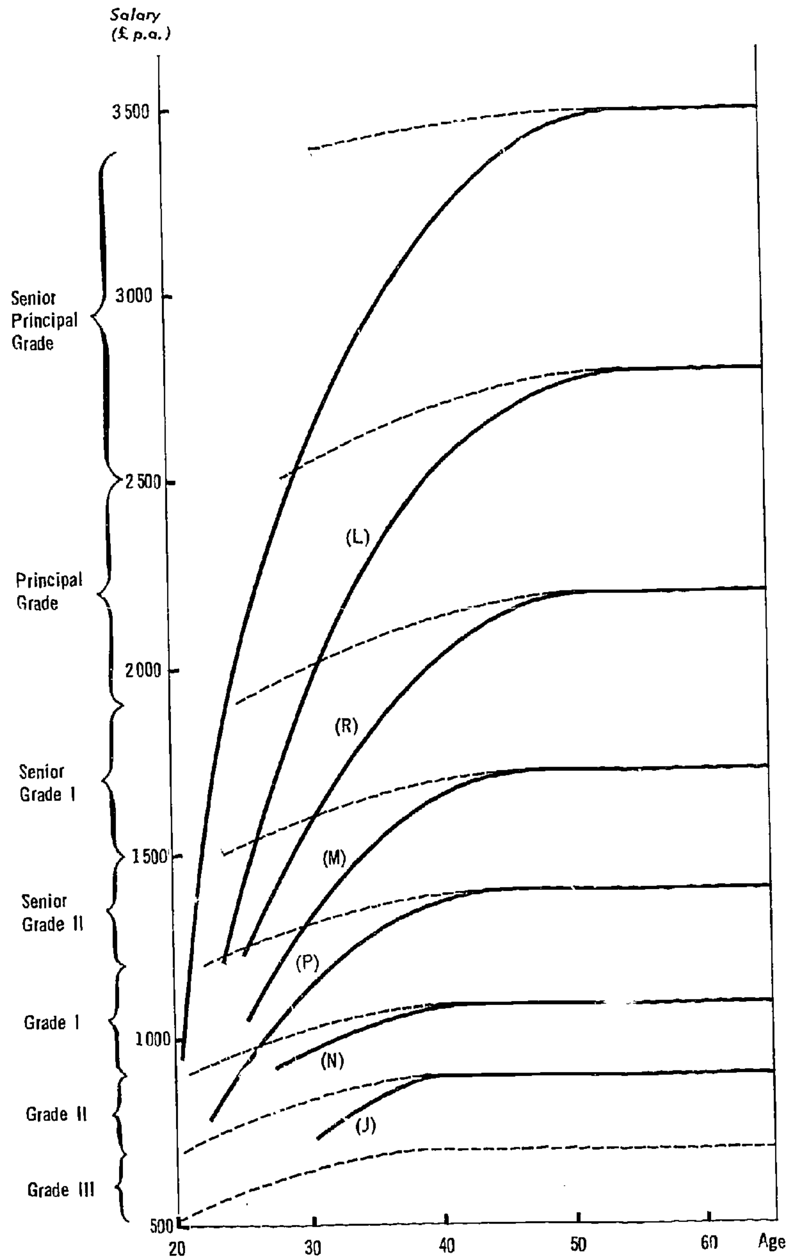
It will be clear that the SPG system, as outlined in Chart 2, has much in common with the concept of age-earnings profiles, particularly in view of the use of educational qualifications by Firm 1 as a device for calibrating its personnel. This approach indicates that it may be more useful to see an individual as having not one occupation but a whole series of occupations over his working life. The broad spread of educational attainments discovered for individuals in a given occupation may be a reflection of this dynamic approach to a firm's manpower utilization (1); some individuals in a given job level (the "stickers") may have reached their ceiling within the job hierarchy, whilst others, perhaps with high educational qualifications and promise, (the "movers") are merely passing through, on route to more senior jobs.

In Section I, we referred to the need for a firm to optimize its labour force as a durable stock. There is some American evidence to show that the great majority of high level executives reach their positions from promotion within the firm, after long periods of service and that their inter-firm mobility is very limited (2). Occupational pension schemes have been used by firms in the United Kingdom to reduce the turnover of senior men and the compilation of "executive development registers" by a number of United Kingdom firms are further indications that some firms are aware of the need to plan the use of their labour force over time and particularly to retain and groom for higher responsibility those individuals who are likely to be able to hold positions of seniority in the firm in later years. If individuals of higher educational attainment were more able and motivated and easier able to assume positions of responsibility (i.e. the higher educated were the "movers"), then this would add support to the view that firms use educational qualification as a selection device for indicating the personnel who are of greatest potential value to the firm. These would then be suitably rewarded and given early opportunities for advancement, in an attempt to reduce their turnover and generally to commit them to the firm. This would perhaps account for the tendency of the age-earnings profiles of higher educated

(1) We take up this question further in Section VI.

(2) See L.R. Burgess: "Top Executive Pay Package", Glencoe: The Free Press of Glencoe, 1963; D.R. Roberts: "Executive Compensation", Glencoe: The Free Press of Glencoe, 1959.

Chart 2



Firm 1's Salary Progression Grades

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individuals to lie above those of the lower educated in the early years, and for the distance between them to widen with age.

V. Occupational classifications

The manpower literature reveals a difference of opinion between various experts about the classification of occupations for purposes of forecasting manpower needs. Michel Debeauvais suggests that the labour force might be classified at the outset of the forecasting exercise into six distinct levels of educational attainments; in short, he proposes to define occupation by education (1). Herbert Parnes, on the other hand, argues that it is conceptually impossible to group occupations by level and type of required education, if by "occupation" is meant a skill-category defined in terms of the tasks and functions that are actually performed independently of the industry or economic section in which they are performed (2). It is true, of course, that it is possible to draw up an educational profile of the labour force in terms of equivalent levels of educational attainment, and then to study the distribution of this profile among industries and sectors. But for purposes of forecasting the educational requirements of a growing economy, it is necessary to relate this profile to the actual jobs held by people with different amounts of education, and this brings one back to the need for a genuine occupational classification. Parnes' point is that whenever we classify the work people actually do into more or less homogeneous job-clusters, these clusters or occupational categories turn out to be distributed among several educational levels. Sten-Olöf Döös reinforces Parnes" argument by emphasizing the desirability of keeping occupational classificatory schemes separate and distinct from educational categories: engineers are people who perform similar tasks; they are also people who have received a special type of education leading to an engineering degree or diploma (3).

The fundamental objection to defining "occupation" by the level of education and training required is simply that, even if it were feasible, it would preclude asking any questions about the optimum utilization of educated people. If an engineering occupation is simply all jobs held by people with engineering education, any questions about trained engineers working as salesmen, or technicians designing and constructing machinery, are ruled out by definition. In the same way, all problems about substitutability between people with different amounts and types of education are eliminated or, rather, turned into questions about occupational mobility.

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(1) M. Debeauvais: "Methods of Forecasting Long-term Manpower Needs", in "Planning Education for Economic and Social Development" Paris, OECD, 1963.

(2) H.S. Parnes: "Manpower Analysis in Education Planning", ibid. pp. 78-79.

(3) S.O. Döös: "Forecasting Manpower Requirements by Educational Categories", ibid. p. 124.

We conclude that occupations must be defined in terms of the nature of the job, without any reference to the characteristics of the people who will or should take them up. Unfortunately, occupational census classifications, such as those adopted by the General Register Office (1960) Classifications of Occupations, or the American Dictionary of Occupational Titles, do not satisfy this criterion. For a variety of historical reasons, these censuses classify occupations partly by job content, partly by the type and level of skill required to carry out the job, and partly by the social-prestige rating of the work performed; in short, occupations are in some measures defined by the types of people commonly observed in them (1). This criticism applies to some extent to the International Classification of Occupations (ISCO)(2). The ISCO takes great pains to define an occupation in terms of the functions and duties involved in the work to be performed without reference to the educational qualifications normally associated with it. In practice however, educational qualifications are used to define certain high-level technical jobs. For example, the following statement appears in the general job description for an engineer:

> "Those classified in this unit group have obtained university degrees in engineering or equivalent qualifications and frequently hold licences or certificates issued by a professional or governmental organisation"(3).

The question arises: can those performing high level work be classified into different occupations without resort to their educational qualifications? The problems of classifying high-level work arises because the jobs have so many facets. Examples of the many aspects of executive work are given by Hemphill, who has classified executive work along ten dimensions, covering both the degree of authority exercised, and the spheres in which the work falls (4). Which of the various characteristics of a job one should select to define it, will vary according to one's objective. As we have seen, one may use the short-cut of a single

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(1) For example, in the "Notes on Coding Occupations" attached to the General Register's "Classification of Occupations", a paragraph is devoted to the difficulty of defining professional and technical occupations. The rule laid down for engineering jobs contradicts the claim that the occupational classification "takes accoun' nly of the nature of the work performed by the individual". They say: "If the specific title is prefixed by the term professional, chartered, advisory, chief, consultant, consulting, designing, development, research, senior, superintending or membership of a professional institution is stated, e.g. AMIEE, it is assumed that the person is a professional engineer. In cases of doubt, the person is regarded as non-professional".

(2) "International Standard Classification of Occupations", International Labour Office, Geneva 1958.

(3) Op. cit. p. 28

(4) "Harvard Business Review", 1959. The dimensions cited are: Providing a staff service in non-operational areas; supervision of work; internal business control; technical aspects of products and markets; human community and social affairs; long-range planning; exercise of broad power and authority; business reputation; personal demands; preservation of assets.

parameter (such as educational requirement); but it does seem that only heroic aggregation and omission of information relevant to manpower planning permit one to allocate high-level work to mutually exclusive pigeon-holes defined by a single characteristic. At the other extreme one may take account of a whole group of parameters and convert them to a single scale measuring "level" by a point system.

Perhaps one reason why most occupational classificatory schemes include education and training among the criteria for grouping together occupations is the reluctance to face up to the difficulties of scientific "job-analysis", (a list of the duties involved in a job)(1). Job-analysis is the first step towards "job-specification" (a list of the abilities required of the person who is to perform the job successfully), and "job-evaluation" (the process of determining the worth of one job in relation to another, without regard to personalities), and, needless to say, the conversion of occupation into education can be only an inspired piece of guesswork without job analysis and job-specification.

All firms make use of job-evaluation for purposes of constructing salary grades, but these are not necessarily based on scientific job-analysis or job-specification. In some cases, salary grades are predetermined before the jobs themselves are ranked, with the result that the job-description consists of little more than a few sentences describing the relative value of that job to the company. In other cases, the job-description is in fact nothing more than a rationalization of the salaries and qualifications of the employees currently occupying different jobs, that is, a ranking of people rather than of the jobs themselves. The more sophisticated technique of job-evaluation uses the method of "points rating", in which the job is broken down into its component factors and these are evaluated separately (one such points-rating system is that of the Canadian Marconi Company mentioned below in Section VI). Such a scheme necessarily produces a detailed job description, but it does not appear to be frequently employed in British industry (2).

Only one of the five firms investigated in the pilot-phase of the study had carried out job-analyses and job-specifications. This made it possible to compare the educational requirements stated or implied in the job-description with the educational attainment of the person occupying

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(1) For a g[illegible] discussion of the content of job-analysis, see the pamphlet by the National Institute of Industrial Psychology, "Studying Work" (London 1951).

(2) Some job-evaluation schemes in Britain explicitly reject the idea of basing salary grading on job-analysis, as this term is commonly understood. According to E. Jaques ("Measurement of Responsibility", London 1965), every job can be evaluated by measuring its "time-span of discretion", the length of time for which an employee is responsible for decisions without supervisory review. According to this method, "wages and salaries are paid on the basis of the resources entrusted to the discretionary control of the person in a job. The percentage paid is equivalent of the cost to the company of its material resources, as assessed by the rate of interest the company must pay for borrowing money". Dr. Jaques' chief claim for this method is that it appears "fair" to workers, thus minimizing industrial disputes.

that job. Where the two do not match, it is perfectly possible that the explanation lies in an inaccurate statement of educational requirements. It will be recalled that a job-specification states the abilities or skills required of the individual who is to perform the job successfully; many job-analysts translate this objective list of abilities into equivalent educational standards so as to facilitate selection for hiring purposes. The last step in the exercise, however, may be based on purely conventional notions about the ability levels implied by different educational standards. Nevertheless, if a firm has undertaken job-analysis in the recent past, it is possible to group jobs into homogeneous classes and to analyse discrepancies between educational requirements and attainments. Indeed, we adopt this approach in Section VI, in our discussion of the problem of malutilization. But the real question arises with regard to those firms who lack job-specifications and who grade salaries simply by ranking jobs partly in terms of the job itself but also partly in terms of the typical individual occupying the job.

There are two possible lines of approach whenever such firms are encountered in the sample. One way is simply to ignore all occupational classifications and directly to compare the educational profiles of such firms with their economic performance. This amounts to Debeauvais' suggestion mentioned earlier and might be described as an educational classification of the labour force travelling in the disguise of an occupational classification. In this approach, the personnel of the firm might be distributed into six or seven mutually exclusive educational categories; these could then be weighted and summed to provide a single index of education-intensity. Such indices of education-intensity for different firms can then be statistically compared with indicators of differential economic performance. The results are bound to throw some light on the question of malutilization of educated people, but only for firms as a whole, not for individual jobs. The second approach is to adopt a functional classification of the labour force, possibly in conjunction with a more or less traditional census classification of occupations within functions. By "function" is meant a department of the firm or a stage in the manufacture of the final product. Typical functional levels recognized in industry are research and development, administration, sales, manufacturing and the like. The advantages of the functional classification are that it is simple to apply because firms are frequently organized along functional lines, and that it permits analysis of educational inputs at a less aggregative level than the individual firm; educational profiles can then be compared among different functional groups within the firm and among similar functional groups in different firms.

VI. The malutilization of educated manpower

As we pointed out in Section I, the manpower forecasting approach to educational planning usually consists of a calculation of the future occupational composition of the labour force implied by certain growth targets for the gross domestic product, and the subsequent translation of these requirements by occupational categories into requirements by educational

qualifications. The chief difficulty in the exercise is the last step, namely the conversion of the estimates of manpower requirements into estimates of educational requirements. As manpower planners themselves candidly admit (1) no one has so far discovered a stable relationship between occupation and educational background, except for a few highly specialized professions with legal entry restrictions. Yet, the notion that there is a definite connection between occupation and education, a connection which future research will discover, is fundamental to the manpower approach. Unfortunately, the kind of aggregative studies that have hitherto characterized manpower research have been incapable of demonstrating this connection: they have looked at the question two or three steps removed from the agent hiring educated manpower, the individual firm. But if there is indeed a systematic relation between the jobs that people do and the education they have received, it is thought that this would be most clearly revealed at the level of the business enterprise.

A way of getting at this relationship is to look at firms with developed systems of "job-analysis" and to compare the statements of educational requirements in their "job-specifications" with the empirically observed qualifications of personnel actually employed in jobs. This exercise was possible in Firm 3 (a firm in the motor industry) and was carried out during the piloting phase of our study. This firm operated an extremely comprehensive and well-tried system of job-analysis; the company published a handbook for its staff trainees on "Job-Evaluation" in which the principles used were justified and related to the salary structure. The factors used in the evaluation of jobs were:

1. Experience acquired in lower or related jobs
2. Specialized or technical education required
3. Manual, physical skill
4. Physical effort
5. Complexity
6. Seriousness of errors.

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(1) See H.S. Parnes: "Forecasting Educational Needs for Economic and Social Development", Paris: OECD, 1962, pp. 19, 20, 37, 41, 44; H.S. Parnes: "Relation of Occupation to Educational Qualification", in "Education for Economic and Social Development", Paris: OECD, 1963, p. 148; and F.H. Harbison, C.A. Myers: "Education, Manpower and Economic Growth" New York: McGraw-Hill, 1964, pp. 205-6. The issue came up again recently with the publication of C. Leicester: "Economic Growth and the School Leaver", in "CRAC Journal of the Careers Research and Advisory Centre", Summer, 1964, and B.J. Holloway: "Manpower Starvation by 1970", in "New Scientist", 12th November , 1964. Leicester and Holloway assumed that there was no problem about translating manpower needs into educational needs, an assumption which was denied by G. Jones: "The Needs of Industry", in "CRAC", Autumn, 1964, and by W. Jackson, C.A. Moser and E.S. Sellers: "New Scientist", November, December 1964.

7. Hazards
8. Adverse working conditions
9. Contacts with outsiders
10. Contacts with other departments
11. Responsibility for the safety of others
12. Responsibility for company funds or property
13. Responsibility for confidential information
14. Performance of work without immediate supervision
15. Supervision of others.

The list indicates the complexity of the relationship between educational qualification and job classification (1).

In the job-specifications, company job-analysts were asked to indicate "in definite terms, the minimum level of academic education essential to proper performance of the job, citing specific qualifications and/or recognized levels of attainment". Educational requirements were so specified for the jobs of 292 of the individuals for whom personnel data had been collected. The sample however was a restricted one: it excluded operatives and was limited to lower and middle level clerical, technical, and managerial staff, earning up to about £2,000 p.a.; for 423 individuals in our sample no educational requirements had been specified. The following matrices present the relationship between the actual educational attainments of people holding jobs and the required educational level for jobs as specified by the companies' job-analysts. These requirements-attainments matrices range the educational qualifications distinguished by Firm 3 in its job-evaluation procedure along a crude scale, with separately distinguished qualifications of the same educational level being placed in adjacent bowes. These educational qualifications (or their equivalents) are as follows:

Secondary Education:	Completion of course of secondary education
RSA	Royal Society of Arts or other examination or course (e.g. 6 months typing course) judged to be below GCE "O" level standard
"O"	GCE "O" level or equivalent
C. and G.	City and Guilds Final Craft examinations
"A"	GCE "A" level or equivalent

(1) Although the weights assigned to each factor are not known in this case, in another well-known job-evaluation system (that of the Canadian Marconi Co.), education accounts for less than one-seventh of the overall maximum points that can be assigned to any category.

Prof. I	Completion of Part I of professional examinations, e.g. of Institute of Chartered Accountants
ONC	ONC/OND or equivalent
HNC	HNC
Prof. II	Professional qualification - e.g. Chartered Accountant
Degree	University Degree, Dip. Tech. etc.

Matrix I may be interpreted as showing to what extent the educational attainments of people holding jobs for which an educational requirement is specified do, in fact, match up to these requirements. Educational attainments may be of a similar level to specified requirements or placed higher or lower on the scale. It must be borne in mind, of course, that there is a certain arbitrariness in the level of education and experience written into a job-specification. Moreover, those responsible for making appointments will not necessarily agree perfectly with job-analysts about the equivalences of various qualifications. Subject to this caveat, however, we can conclude that:

(a) if requirements equal attainments for every job specified, as might be assumed in the crude approach to manpower planning, all observations will lie along the diagonal of the matrix;

(b) observations falling above the diagonal indicate that people are "undereducated" in the sense of being employed in jobs requiring higher educational qualifications than they in fact possess, or else in jobs requiring qualifications of a similar educational level but of a different type (e.g. ONC rather than GCE "A" level);

(c) similarly, observations falling below the diagonal indicate that people are "over educated" in the sense of being employed in jobs requiring lower educational qualifications than they at present hold, or else in jobs requiring qualifications of a similar educational level but of a different type.

Reference to Matrix I shows that over two-thirds of the job for which educational requirements were specified are filled by under-qualified men, or else by men with the right level but wrong type of qualification. It is noteworthy that only one-fifth of the occupants of jobs were observed to have the precise qualification corresponding to the job-analyst's conception of what was required by the job.

In Matrix I, we include as separate categories all the different types of educational qualifications because the modes of training underlying these qualifications vary considerably, as do the range of subjects studied. Hence although of a similar educational level, there may be little substitution between these qualifications in the context of educational requirements for particular jobs. In matrix II, we have consolidated the various educational-qualification categories into groups of broadly similar levels of educational attainment, corresponding to the six-level classification adopted in Section IV.

The observations in the educational level matrices may be interpreted as follows:

(a) Observations falling along the diagonal indicate that the educational qualifications of the individuals holding these jobs correspond to the educational requirements specified by the firm.

(b) Observations falling below the diagonal indicate personnel with educational levels that would qualify them for a group of jobs with a "higher" educational requirement than that of the actual job in which they are employed. The implication is that of wasteful employment of qualified and hence expensive personnel; one explanation for this may be what we earlier called "conspicuous consumption" of educated manpower, which, in a large inter-firm study, should be reflected in comparative value-added figures and other indices of economic performance. For the individuals concerned, the implication is that they are unable or unwilling to take a job for which their educational attainment would fit them. These results could, however, be the reflection of an excess supply of qualified personnel in the economy: the lower the salary differential of higher over lower qualified personnel, the more rational the action of firms employing "overeducated" personnel, and the more rational the action of individuals in accepting work of a level below that for which they are qualified.

(c) Observations falling above the diagonal would indicate that jobs are being filled by men whose educational attainments do not match up to the requirements specified by the firm. In the absence of data on their performance, it must be assumed that these individuals have acquired equivalent education through on-the-job experience. A readily available indication of job performance is provided by the annual staff appraisal common in most companies (including Firm 3) and which is carried out by departmental managers and supervisors as par of the annual salary review procedure. If it were true that individuals filling jobs for which they were not formally qualified did perform less well than others with adequate qualifications, then this would be indicated by a concentration of those individuals with low performance ratings in boxes above the diagonal in matrix II (1).

It will be seen from Matrix II that the effect of consolidating the various types of qualifications does not significantly improve the result: 22 per cent of observations fall on the diagonal, as against 21 per cent in Matrix I. This indicates that there is little substitutability between educational qualifications of different types but of a broadly similar level.

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(1) Although job performance data of this sort was not collected on this occasion, we hope to do so in our future work on the educational attainment-requirement relationship in firms.

Requirements-Attainments Matrix I

Educational qualifications (all employees)

Attainments	Requirements: Sec.Ed.	RSA	"O"	C & G	"A"	Prof.I	ONC	HNC	Prof.II	Degree	Total	Numbers: No requirement specified
Sec. Ed.	15	17	48	3	8	7	35	30	1	2	166	357
RSA. . .	2	7	1	1	3	1	1	2	0	1	19	25
"O" . . .	2	1	18	0	3	2	2	0	1	1	30	6
C & G . .	0	0	1	1	0	0	7	13	0	0	22	10
"A" . . .	0	0	3	0	0	1	3	1	0	0	8	3
Prof. I .	0	0	0	0	0	2	0	0	1	2	5	4
ONC. . .	0	0	4	0	0	0	9	3	0	0	16	9
HNC. . .	0	0	0	2	0	0	7	7	0	0	16	1
Prof. II .	0	0	0	0	1	0	0	0	0	0	1	2
Degree. .	0	0	0	0	2	0	3	3	0	1	9	6
Total. . .	19	25	75	7	17	13	67	59	3	7	292	423
									Total observations:			715

	No.	Per cent
Requirements > Attainments	201	68.8
Requirements < Attainments	31	10.6
Requirements = Attainments	60	20.6
	292	100.0

Requirements-Attainments Matrix II

Educational levels (all employees)

Attainments	Requirements 0	1	2	3	4	5/6	Total	No requirements specified
0	15	17	51	50	30	3	166	357
1	2	7	2	5	2	1	19	25
2	2	1	20	14	13	2	52	16
3	0	0	7	15	4	3	29	16
4	0	0	2	7	7	0	16	1
5/6	0	0	0	6	3	1	10	8
Total. . . .	19	25	82	97	59	10	292	423
							Total observations:	715

Key:

Level		Qualification
0	....	Sec. Ed.
1	....	RSA
2	....	"O" level C and G
3	....	"A" level Prof. I ONC
4	....	HNC
5/6	....	Prof. II Degree

Summary:

	No.	Per cent
Requirements > Attainments	197	67.5
Requirements < Attainments	30	10.3
Requirements = Attainments	65	22.3
	292	100.0

The data presented in Matrices I and II refer to employees who have gone through the educational process and have entered the firm's service at widely different dates. The output of the educational system, as well as the occupational structure and employment policy of the firm, cannot be assumed to have been the same throughout the period covered. The data for employees who entered the labour force more recently, e.g. those under 30, would be expected to yield more useful information on educational/occupational relationship. Unfortunately the exclusion of all employees over a certain age would involve the rejection of data refering to the more senior posts generally held by older men. However, separate consideration of more recent engagements by the firm should show a greater consistency between firm policy and practice, and reflect the present state of supply and demand in the labour market. The data was reclassified into two groups, containing respectively individuals joining the firm within the past ten years, and those who have been with the firm for ten or more years. Separate matrices were compiled for these two groups in terms of the educational levels used in Matrix II. These results are shown in Matrix III and Matrix IV.

Requirements-Attainments Matrix III

Educational levels (employees under 10 years with the firm)

Attainments	Requirements							No requirements specified
	0	1	2	3	4	5/6	Total	
0	6	9	16	8	5	0	44	92
1	1	6	1	0	0	0	8	17
2	1	1	20	12	7	1	42	4
3	0	0	7	11	3	2	23	5
4	0	0	1	6	3	0	10	0
5/6	0	0	0	5	1	4	10	3
Total	8	16	45	42	19	7	137	121
				Total observations:				258

Summary:

	No.	Per cent
Requirements > Attainments	64	46.7
Requirements < Attainments	23	16.8
Requirements = Attainments	50	36.5
	137	100.0

The data for employees under ten years with the firm, shown in Matrix III, do in fact conform to our expectation of a much greater degree of consistency, in the sense of a greater percentage of observations along the diagonal, than the data in Matrix IV for employees who have been ten years or more with the firm: 36.5 per cent as compared with 11.3 per cent. The fact that the percentage underqualified is very considerably higher (85.4 per cent as opposed to 46.7 per cent) among the longer-employed points to the growth in output of qualified manpower over the past decade; it may also reflect the latter's promotion within the firm since recruitment. In other words, the finding is consistent with the assumption that the qualifications of these individuals, when originally recruited, did match specified job requirements, and that, subsequently, they were promoted to higher level jobs as a result of experience and seniority. What is less easy to explain is the fact that almost 50 per cent of those who have joined the firm in the past ten years are underqualified for the jobs they now hold, and only a third are in jobs with specified requirements corresponding to their educational attainments. These results do little to support the crude manpower-planning approach in terms of rigid educational requirements for jobs, or the popular belief that there is under-utilization of manpower, in the sense of over-qualified people being employed in jobs requiring little education.

Requirements-Attainments Matrix IV

Educational levels (employees 10 or more years with the firm)

Attainments	Requirements							No requirements specified
	0	1	2	3	4	5/6	Total	
0	8	8	33	42	25	1	117	243
1	1	1	1	5	2	1	11	8
2	1	0	0	2	6	1	10	12
3	0	0	0	4	1	1	6	11
4	0	0	1	1	4	0	6	1
5/6	0	0	0	1	0	0	1	3
Total	10	9	35	55	38	4	151	278
					Total observations:			429

Summary:

	No.	Per cent
Requirements > Attainments	129	85.4
Requirements < Attainments	5	3.3
Requirements = Attainments	17	11.3
	151	100.0

For the manpower planner, the most interesting part of the matrices are the south-east corners, showing those qualifications for which the gestation-periods, the input costs, and therefore the need for planning are greatest. For instance, of 19 jobs filled by men engaged less than 10 years ago, formally requiring a HNC, 15 occupants have a lesser qualification and 5 have no qualification beyond completion of secondary education. The small number of observations makes it impossible to generalize from these matrices; in any case, such matrices cannot be accepted uncritically as indicating actual supply and demand conditions without reference to relative earnings. Still, they could provide, in conjunction with data of the output of the educational system, a rough indication of where discrepancies between demand and supply of educated manpower will arise in the immediate future.

None of the other pilot firms possessed sufficiently detailed job-specifications to enable us to draw up similar matrices. Indeed, we found a considerable variety in the way in which pilot-study firms categorized their occupations or job-functions, if they categorized them at all. This lack of standardization between firms in job-classification schemes and recruitment procedures is itself a fact calling for comment and explanation. Examples of two possible approaches, differing markedly in conception and in effect, are furnished by the recruitment policies adopted by Firms 1 and 3.

Firm 3 operated its own system of job-analysis and job-evaluation, based on fairly detailed job-specifications. On the other hand, as we have seen in Section IV, Firm 1, a leading firm in the rapidly growing electrical engineering industry, had not developed an occupational classificatory scheme for its salaried staff; there was not even conformity of job-titles between different divisions of the firm. Instead, the firm employed a grading of salaried staff by means of something it labelled "Salary Progression Grades" (SPG's), that is, a set of predicted salary paths through time to which each new qualified recruit was assigned on the basis of his educational qualifications. The value placed on a recruit depended more on the ultimate position that his education showed him to be capable of filling, than the job he exercised immediately on entering the firm.

Hence, whereas Firm 1 emphasized the "rate for the man" and tried to tailor the progression of jobs through which a man passed to his qualifications, Firm 3 looked at the "rate for the job" and tried to settle on the most suitable educational requirement for a recruit engaged to perform the tasks that comprise a particular job.

In evaluating the effects of these two different policies, we must be careful to distinguish between what the systems were designed to achieve, and what they in fact achieved. Firm 3's more conventional picture of an occupational structure made up of a series of well-defined positions to be filled and of the ideal combination of qualities of the person recruited to each position, resulted, as we saw, in a considerable degree of inconsistency between the educational requirement of a job and the actual attainment of the occupant, especially among employees who had been 10 years or more with the firm. Their system of job-specification and evaluation, using a factorial analysis to define and estimate the worth of each job, amounted to an attempt to "find the man to fill the job", an attempt that was frequently unsuccessful. (For example, even among employees recruited in the previous ten years, 64 per cent were not

holders of the qualification specified). Firm 1's "Salary Progression Grades", on the other hand, embody a dynamic conception of an individual's contribution to the firm, and the emphasis lies on fitting the job to the man at each stage in his career, so that, in receiving a competitive salary, he is not being paid more than the job is worth.

In theory, for Firm 1, there is a one to one correspondence between educational qualifications and occupational grade on entry into the firm at 21; however, this grade covers a range of different "occupations", in the manpower planner's sense of the word. The actual distribution of manpower may have conformed better to recruitment principles in this case than in that of the job-specification approach used by Firm 3, despite the formal possibility of revising the assignment of an individual to some other SPG according to his performance. But, this possible greater consistency is at the cost of an accurate breakdown of occupations correctly described - indeed, the use of SPG's as definitions of occupations would lead to anomalous responses to official questionnaires (1).

SPG's, thus show a correspondence not so much between type of education and occupation, functionally defined, as between level of education and level in the occupational hierarchy. Such a relationship, even if demonstrated to be more stable than that between otherwise defined occupations, curricula and types of educational preparation, is of limited use to the firm in determining its needs for educated manpower in the short term; Firm 1 was indeed in the process of adopting the Canadian Marconi Company job-evaluation system, (which employs criteria of generalized application for estimating the salary a job should command, like those used by Firm 3), for use in conjunction with the SPG system (2).

The SPG system is primarily a means of reducing the numerous characteristics of jobs to a single dimension for the purpose of placing them along a scale and have little to do with that description of duties or productive functions which would be expected to relate to technique of production. On the other hand, a static job-specification such as that of Firm 3 makes no predictions as to the employment of educated personnel at any point in time after their engagement; in other words, the manpower planner is left in the dark as to the ultimate destination of qualified personnel, and can relate immediate vacancies in junior or middle-level jobs to only qualified entrants into the job-market.

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(1) Indeed, this was true of Firm 1's completion of the Ministry of Labour's annual survey of occupations.

(2) Canadian Marconi Company Job Evaluation Scheme

Factors	Maximum Points
Education and Basic Knowledge	100
Experience	150
Analysis and Judgement	75
Supervision Received	60
Responsibility for Contacts with others	80
Responsibility for Confidential Data.	25
Responsibility for Supervision	160
All other responsibility	80
Total	730

VII. The rate of return on invest in education

In recent years much interest in the study of the economics of education has centred round the concept of education as human capital formation. Using the same discounted cash-flow techniques that industry is now finding useful for physical investment calculations, it is possible to estimate the rate of return to society on investment in human capital. What is involved is a systematic comparison of the present costs of educational provision to the community - in terms of the monetary value of the goods and services that must be withdrawn from other uses to provide educational facilities - with the increase in GNP in future years resulting from these educational expenditures as reflected in the salary differentials of those individuals who have benefited from the extra education provided.

Rate of return analysis and manpower planning

Before describing the results of such calculations, however, we must pause a moment to consider its practical relevance to manpower planning - a point frequently glossed over by the advocates of rate-of-return analysis. All manpower forecasts must begin with an assessment of the current manpower situation, inasmuch as even the most sophisticated forecasting techniques necessarily involve extrapolation of current trends. In forecasting the demand for engineers by 1970, for example, the first question to answer is: is there now a shortage or surplus of engineers? This raises the famous problem of defining what we mean by shortages or surpluses of particular types of manpower. Ignoring all those definitions which run in terms of some vaguely defined "social need", the economist's definition is clearly some variant of the Blank-Stigler measure: "in an economy with a free labour market ... a shortage exists when the number of workers available (the supply) increases less rapidly than the number demanded <u>at salaries paid in the recent past</u>. Then salaries will rise ..." (1). That is, shortages in a developed economy are purely relative - engineers, say, relative to other professional groups in the economy - and are measured by the relative earnings of engineers between two points of time. This test is not always conclusive in dating either the beginning or the final disappearance of a shortage, but it will generally indicate the existence of a significant shortage if there is any competition whatever in the labour market in question. Unfortunately, this test may give false results for highly qualified manpower if the costs of formal professional training are rising or falling. Since entrants into the specialized professions are not drawn at random form the work force, the supply of, say, engineers is influenced by the interaction of training costs and earnings, or, as in the British case, by the decision of the educational authorities to create facilities for the study of engineering, as well as by the prospective earnings of engineers.

(1) D.S. Blank, G.J. Stigler: "The Demand and Supply of Scientific Personnel", New York: National Bureau of Economic Research, 1957, pp. 19-33.

The fact that the supply of highly specialized manpower is a function both of the financial rewards that induce new entrants into these professions and of the financial costs of training that may deter other potential entrants, is neatly summarized by an internal rate-of-return figure, defined as that rate of discount which equates the present value of the expected earnings stream to the present value of the expected cost stream. We may now define a shortage as occurring when the supply of say, engineers increases less rapidly than the demand for engineers at rates of return earned in the recent past, causing the rate of return to rise. Alternatively, we can compare the rate of return of engineers to some standard rate-of-return of, say, all university graduates. If the rate-of-return of engineers exceeds the alternative rate by some predetermined differential, this can then be taken as evidence of a shortage (1). This has the advantage of allowing conclusions to be drawn from a single point of time, although observations for several dates are naturally to be preferred. Be that as it may, in view of frequent changes in the training costs of specialized professions, rate-of-return comparisons yield more valid tests of the existence of shortages and surpluses than earnings comparisons, and this is one of their major uses in manpower planning.

At this stage of our work, insufficient data have been collected to enable us to calculate the internal rate-of-return on investment in the education of engineers, mathematicians, accountants and so forth. Hence, we are not able in the present paper to demonstrate this particular application of rate-of-return analysis to manpower planning. On the other hand, we have assembled sufficient data to calculate the rate-of-return on investment in different levels of education and the rate of return figures presented subsequently are of this type. The method is to discount the cross-section age-earnings profiles (Table 4) associated with each educational level and to compare these with their discounted costs in terms of total resources committed. This method is perfectly applicable to ivestment in the education of particular professions also, and analyses relating to investment in education of different types, as well as levels, will constitute an important feature of the Industry Project in its later phases.

Summary results and conclusions

We now present in Table 5 summary results of the calculations described in the preceding pages. As we have seen, the social rates of return shown in the table relate the discounted present value of the before-tax earnings differentials associated with various educational levels to the total resource costs of providing these levels, including the earnings foregone by students. The private rates of return relate the discounted

(1) For an interesting application of this technique to physicians in the United States, see the pioneering essay by W. Lee Hansen, "Shortages and Investment in Health Manpower", the Economics of Health and Medical Care. Ann Arbor, Mich.: Bureau of Public Health and Department of Economics, the University of Michigan, 1964.

present value of the after-tax earnings differentials to the purely private costs of obtaining the various qualifications. All the unbracketed figures express a comparison with the base-level 0; the bracketed figures in each refer to the extra costs and earnings over the previous level, except for level 6 where the relevant base-level is level 4 rather than level 5. Our present calculations did not enable us to estimate the rate of return for those educational levels with rates of return exceeding 10 per cent, although in all but one case it seemed clear that the rate of return did exceed 15 per cent, in one case considerably so.

In summarizing our results in the form on single rate-of-return figures, we have lost much of the information relating to the actual time shape of the earnings streams presented in the preceding two sub-sections. This information, as we have seen, is conveniently represented by calculating and then graphing the net present values of the earnings-minus-costs streams at various relevant discount rates in the present case, for rates from 0 - 10 per cent. This allows the reader to select his own standard alternative "rate-of-return" and evaluate the earnings and costs.

To what alternative standard rate-of-return shall we compare the figures shown in Table 5? One of the authors previously calculated the rate of return on ivestment in all secondary and higher education in Great Britain in 1963 (1). These calculations showed a social rate of return on secondary education (roughly, levels 1, 2 and 3) of 12 1/2 per cent, and a rate of 8 per cent on all secondary and higher education (levels 1 to 6); the corresponding private rates were 13 and 14 per cent. It is evident that these figures generally exceed those in Table 5, a conclusion reinforced by the fact that the standard rate-of-return figures make allowance for certain non-educational determinants of income, whereas the figures we have been considering here simply look at the earnings differentials that are associated with, rather than attributable to, education. If we could generalize from the age-education-earnings profiles of only 3,000 individuals in private industry, we should be forced to conclude that there is no shortage, and indeed a considerable surplus of, people with secondary, technical, and higher education available to the private sector of the economy. But in view of the limitations of the data, such strong conclusions must be treated with extreme caution. We must emphasize once again that no great weight can be attached to the particular rates of return provided in this paper. They are at best illustrative; a far larger and more representative personnel sample would be required before anything more decisive could be said about the magnitude of the social or private rates of return on investment in extra education. We have attempted in this paper to demonstrate a method of analysis rather than to present definite findings; for these we must await the completion of our largescale inter-firm study.

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(1) See M. Blaug: "The Rate of Return on Investment in Education in Great Britain", in "The Manchester School", September 1965.

Table 5

The social and private rates of return

to different levels of education

Level of Qualification (1)	Social		Private	
0 No recorded qualification				
1 Qualifications below "O"-level . . .	5 1/2	(5 1/2)	5	(5)
2 GCE "O"-level	8 1/2	(> 15)	8	(> 15)
3 GCE "A"-level, ONC	7	(< 0)	8	(1 1/2)
4 HNC	7 1/2	(> 10)	9 1/2	(> 15)
5 Pass Degree	6	(5)	8 1/2	(7)
6 Hons.Degree (1st and 2nd)	8	(8)	9 1/2	(10)

(1) See Appendix I for a fuller explanation of the levels of qualification

VIII. Conclusions

Presumably, the most pertinent conclusion of a series of pilot projects concerns the value of proceeding further. It seemed to us, on the basis of what we learned in the piloting work, that the large-scale study of a whole industry, and then of several industries, was worthwhile and, indeed, the major study is already well underway.

Since that was the primary purpose of these pilot projects, it might be thought inappropriate to draw any other conclusions at all. As has been remarked in the introduction, however, that would underestimate the value of our piloting work considerably. We do believe we have arrived at a number of results, empirical theoretical and methodological, which are worthy of mention in their own right, and point to further new directions of study.

First, it is important to emphasize the value of pilot projects as such. In the early stages of preparing for this research we were not fully in agreement as to whether a pilot stage, in the sense that it has been carried out here, was worth all the time and effort that would be involved. Given our economic and statistical knowledge, why not proceed immediately to data collection on a large scale? The answer to this is three-fold:

(i) Available economic theory of manpower was much more limited than we had imagined, and therefore, our own initial theoretical foundation was inadequate;

(ii) Data were much scarcer and more incomplete than we had expected so that we had to develop methods of extracting relevant personnel and economic data from a large number of separate sources;

(iii) If the decision procedures of firms are to be understood, some direct and intimate contact with them is required.

The first and third of these points imply that even if the government were to make available the kind of detailed statistical information mentioned in the body of this report for one or more industries, it would still be advantageous for researchers such as ourselves to do some pilot work in individual firms. Where there are also problems of data limitation, this conclusion is strengthened a fortiori. Indeed, we would advocate pilot projects as a valuable research tool on a much broader basis. To give but one crucial example: the National Plan would have been a much more satisfactory document if it had been proceeded by the kind of detailed look at some individual units of the economy implied in a pilot project.

This leads to a second conclusion about the feasibility of manpower planning at this moment of time. We ourselves are firm advocates of manpower planning and the rational adaptation of our system of education and training to the needs of the economic system. It seems absurd to invest annually hundreds of millions of pounds in human capital without asking whether from an economic standpoint this money could not be allocated more efficiently. (Needless to say we do not want to be interpreted as asserting that the only criterion to be used is the investment and productivity one. But it is obvious that, unless the economic impact of education is to be given no weight at all, some form of manpower planning is both desirable and inevitable).

Despite all this, it also seems apparent that sophisticated manpower planning involving either detailed occupational and educational projections or, more ambitious still, estimates of an optimal occupational and educational structure is out of the question at the present time, and will remain so until further research such as our own very much more are completed. We are in no position even to f late with any confidence occupational and educational relationships, ione do the cost benefit analysis in each case from which optima be derived. Furthermore, if the firms we have approached and studi are typical, manpower projections based on statements emerging fror he business sector cannot be regarded as very reliable. Few firms without a great deal of effort, would be able unaided to provide an accurate picture of their own occupational structure at a point of time, or its changes over time; ever fewer would be able to provide details of the educational structure of their labour force. Given this, even less weight can be attached to their view of the future either as to what is likely or what is desirable on grounds of their own or the economy efficiency.

Thus, what might be called advanced manpower planning cannot be approached along an easy route. There are no short cuts and the necessary detailed research is unavoidable; however, the potential pay-off is likely to be very considerable indeed. If the kind of work we are undertaking and the extensions we have in mind had been begun a decade ago, we should be reaping the benefits now. It is perhaps due to the anxiety by officials and others for immediate returns that real progress has been so slow, and has meant that we began in the United Kingdom almost from scratch two years ago.

Having made our position as clear as possible, we also wish to add one or two more optimistic remarks. The first concerns the interpretation of the age-earning profiles which we have constructed. If these

are at all accurate, they have two noteworthy implications. The first is simply that education in the United Kingdom does have a positive rate of return not excessively out of line with return to capital in the rest of the economy. The second is that return seems higher at the middle pre-degree level rather than at the degree level itself. This suggests that the educational system might be encouraged to adapt itself more to meeting demand at that point. While the margins of error are, as has been emphasized, fairly large, it would be advantageous to look more closely at the technician grade and the activities of the technical colleges and similar institutions in supplying personnel of that kind.

A second conclusion of direct positive relevance to manpower planning is that it is worthwhile paying more attention to the degree of flexibility of educational requirements for particular occupations. Although we have not been able to ascertain optimal educational requirements, we have been able to establish both that the same occupation is staffed by people of varying educational backgrounds and experience, and also that it is not the case that one particular education-experience requirement stands out as obviously right for each occupation. This, of course, also makes the need for manpower planning slightly less pressing.

Our final conclusions are of direct relevance to government action. Perhaps the major bottleneck facing further fruitful research in the manpower planning field is the lack of detailed and disaggregated personnel data. The most comprehensive source for such data is the national census; but there are difficulties in including certain questions of interest to manpower researchers (such as individuals' earnings), and in any case there are considerable time delays before census data are available (1). Clearly, we must rely on private firms for any such improvement in the availability of manpower data. But as we have seen, few firms are in a position to supply accurate data of this sort. There is a role that government can play here in encouraging firms to keep up-to-date personnel records, by making available to firms standardized record-keeping procedures and occupational and educational classifications. There is some indication that a number of private firms themselves are seeing the usefulness of undertaking some form of manpower planning. They may, however, find this not at all easy to do, lacking the necessary background knowledge and experience. The adoption by government of standardized classificatory schemes might encourage such firms to proceed with rationalizing their personnel records. Indeed, there was some indication in our pilot work that the lack of standardized occupational definitions, found in the large number of official labour-force enquiries in recent years in the United Kingdom, has produced anomalous replies to official questionnaires. It seems clear that some rationalization by governments on this front would produce large returns - and in the short run.

(1) Detailed occupational tabulations from the United Kingdom Population Census of 1961, were published as late as January 1966.

Appendix

CLASSIFYING EDUCATIONAL ATTAINMENTS

The personnel data collected in our sample of over 3,000 persons revealed a wide range of educational qualifications and courses of study. In order to construct age-earning profiles, it was necessary to reduce this array of educational qualifications to manageable proportions. The most meaningful grouping for the purpose seemed to be one based on highest academic level achieved. The equivalents shown in Table 1 were those assumed for the comparative analyses of Sections IV, VI and VII of this paper. The most important qualifications at each educational level are underlined.

One major problem has been the change in content of these qualifications over the past 40 years; ideally, we would wish to measure the changes in the relative gaps between the various educational levels that have ensued over recent decades. These educational equivalents must be regarded as purely provisional, and part of our educational as opposed to economic research is devoted to widening our knowledge of the relative importance of different courses of study. The sorts of questions to be answered are these: which qualifications are sufficiently close to be treated as equivalent? To what extent, if any, does the value of a qualification depend on the method of acquiring it? To what extent are experience and training on-the-job substitutes for full-time educational qualifications?

The table includes the qualifications met most frequently but very many others were encountered in the study, and these were assigned on an ad hoc basis to the group which seemed most suitable.

Outline of educational qualifications encountered in the survey

The remaining part of this Appendix is designed for readers not familiar with the English educational system. In general, persons wishing to pursue education after the statutory school leaving age have two alternatives: either to remain at school full-time and obtain academic qualification (General Certificate of Education at Ordinary and Advanced levels) leading to University entrance, or to take a job and attend a part-time course of education though a day release scheme and/or evening study. Persons choosing the part-time method usually attempt to become qualified in either technical or commercial fields. The qualifications listed and briefly defined below are those most frequently found in the survey sample. Chart I shows the main routes leading to the different types and levels of qualification.

1. Academic qualifications

(a) Certificate awarded by the Royal Society of Arts (R.S.A.)

The Society runs school examinations taken mainly by pupils at secondary modern schools. It also awards commercial and technical certificates designed chiefly for students at technical colleges

(b) General Certificate of Education (G.C.E.)

Awarded by certain Examination Boards. The main examinations are at Ordinary ("O") level and Advanced ("A") level, and are commonly attempted by grammar-school pupils aged 16 and 18 years respectively. (Prior to 1951, the corresponding examinations were known as the School Certificate and the Higher School Certificate, and for these awards (unlike the G.C.E.) it was necessary to pass a prescribed selection of subjects at the same examination). Passes in 2 or 3 A-level subjects are usually required for admission to universities.

(c) University degrees

The more advanced under-graduate courses lead to an "Honours degree" (which may be sub-divided into 3-4 classes of merit). Other degree courses are termed "ordinary", "pass" or "general". The typical degree course lasts 3 years.

2. Technical qualifications

Unless specified otherwise, study is part-time, the students obtaining part-time day release from their employer (attending technical college for 1 day and 1-2 evenings per week) or sometimes attending in the evenings only.

(a) Certificate awarded by the City and Guilds Institute of London

School-leavers aged 15-16 follow 2-5 year courses leading to the Intermediate Craft Certificate in subjects such as "mechanical engineering craft practice". Two years further study leads to

Table 1

Educational qualification equivalents (1)

Level	Field of study		
	Academic	Technical	Professional
0	No qualification obtained above school leaving age		
1	RSA general or commerce certificate	City and Guilds Intermediate Craft Examination	
2	GCE "O"-level (or pre 1951 equivalent)	City and Guilds Intermediate Technicians Certificate City and Guilds Final Craft Certificate	RSA Secretarial and Commercial Certificate Stage II
3	GCE "A"-level (or pre 1951 equivalent)	ONC OND City and Guilds Final Technicians Certificate	Intermediate Examination of most professional bodies (e.g. Institute of Chartered Accountants)
4	-	HNC City and Guilds Full Technological Certificate	ACWA
5	Pass, ordinary general degree 3rd class Honours Degree	HND	Final examination of most professional bodies (e.g. Chartered Accountant)
6	Hons. Degree (1st or 2nd Hons.) Post Grad. Degree	Dip. Tech. (1st or 2nd Hons.)	

(1) The major qualifications at each educational level have been underlined.

the Final Craft Certificate. If the school-leavers have passed certain 0-level (G.C.E.) subjects, or if they complete a 1-2 year part-time general course, they may proceed to the technicians Certificate (usually a 4-year course) and then to the Full Technological Certificate (2 more years).

(b) National Certificates

Awarded by the Department of Education and various professional bodies. School-leavers with certain 0-level (GCE) passes (or 17 year-olds who have completed a 1-2 year part-time general course) may follow a 2-3 year course leading to the Ordinary National Certificate (ONC) in subjects such as "engineering". The ONC is roughly equivalent to A-level in the GCE, and students with neither qualification may follow a 2-year course leading to the Higher National Certificate (HNC) Ordinary and Higher National Diplomas (OND and HND) are broadly similar to the National Certificates. They cover a wider range of subjects and are usually obtained by full-time study, sometimes alternating (on "sandwich" courses) with periods of employment.

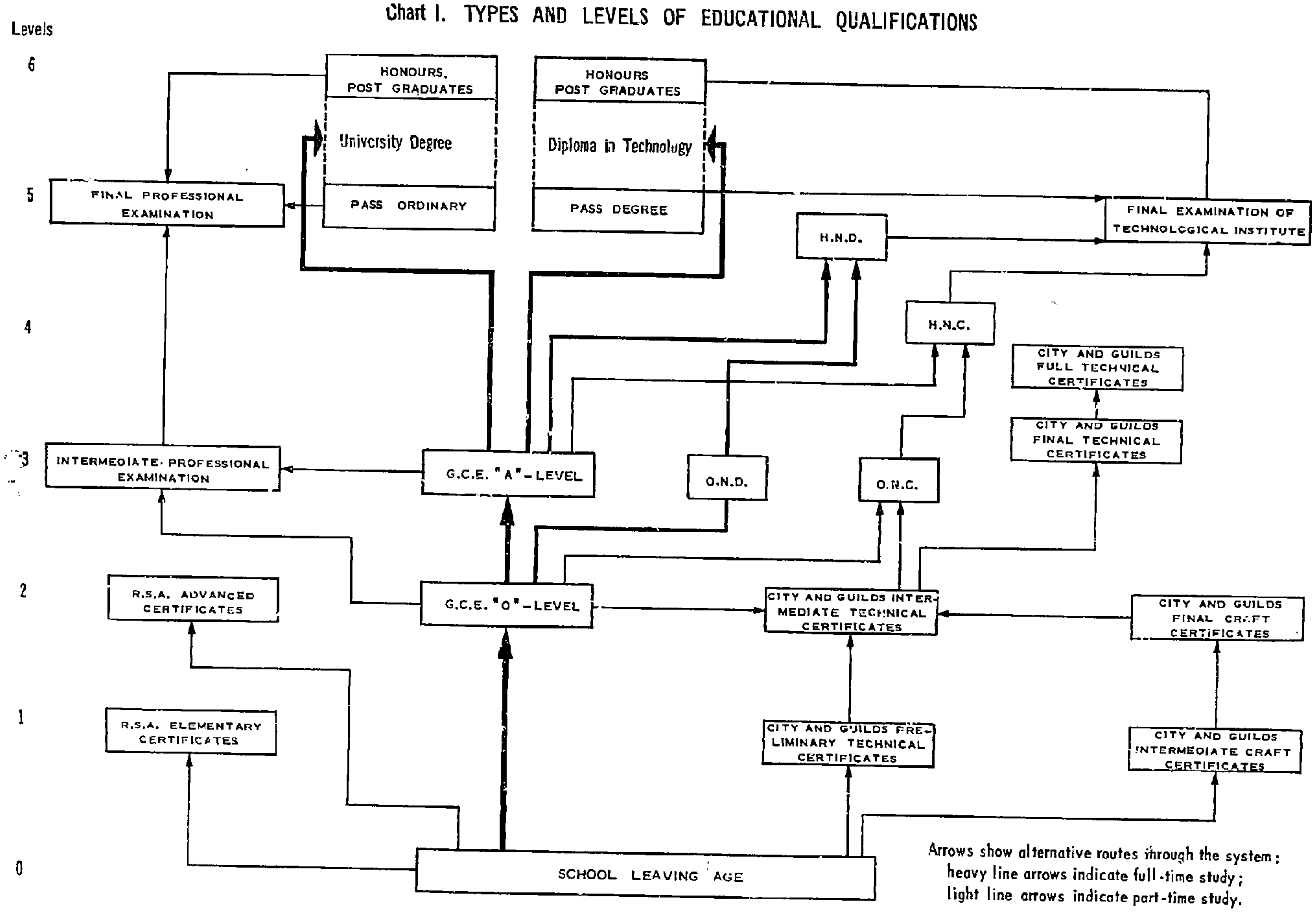
(c) Diploma in Technology (Dip. Tech)

Awarded by the National Council for Technological Awards, but now abolished. The course is a 4-5 year "sandwich" (full-time study alternating with periods of employment) and reaches honours degree standard. Entry requires 2 A-level (GCE) passes or good passes in the ONC or OND.

3. Membership of non-scientific professional institutions

Membership follows a number of years employment in the profession concerned (e.g. Accountancy) combined with evening study by correspondence course for the examinations of the chosen professional institution. There are no alternative full-time formal courses of study leading to these professional qualifications.

Chart I. TYPES AND LEVELS OF EDUCATIONAL QUALIFICATIONS



Arrows show alternative routes through the system; heavy line arrows indicate full-time study; light line arrows indicate part-time study.

IN-CAREER TRAINING
OF HIGHLY QUALIFIED PERSONNEL IN A
LARGE PUBLIC ENTERPRISE

by Marcel Chapuy
Chief of Training Division
Electricité et Gaz de France

I. In-Career Tr ing

Needs - Diff culties - Specific achievements - Resources

The subject of in-career basic and advanced training for scientific and technical personnel has been dealt with in many studies, and an approach to related problems has been made in various bodies. Fairly little is known of the action taken by official national or international organisations, while that taken by industrial firms, although described in publications, has not yet been adequately advertised. Such extensive efforts, whether of a public or private kind, deserve wide coverage. The more frequent, regular and coherent dissemination of information would enable trainers to compare their own efforts with all other action undertaken in this connection; it would show some of the people concerned the short and especially the long-term value of the work to be done, and would expedite action by the responsible agencies.

The main object of this paper is to report on what o French State-owned concerns with a joint training service have achieved. It may be well first to recapitulate the various arguments in support of continued training for scientific and technical personnel, to consider some forms of resistance to such training, and to point out difficulties. Various general measures of a nature to promote requisite action can then be described.

A. The need for continuous training

In this context, it may be assumed that the permanent task of public or private enterprise, and of the Government's agencies and services consists in meeting the needs of the community and in supplying it with "goods" or "services". As a rule, at least in Western societies, it is the job of private enterprise to supply the "goods", while public enterprises or state agencies provide essential "services".

To supply these services under satisfactory conditions the enterprises whatever their nature, must be able to assess the public's needs, create the facilities required for their fulfilment, and manufacture or obtain the products or services desired so that they can be offered to the public.

The enterprise must accordingly both make the needed material investment and seek out and recruit staff with qualifications invariably meeting its standards.

In various State-regulated enterprises or in the civil service, the staff turnover is very low. At national level the active population is highly stable both from a numerical and qualitative standpoint; the number of people able to pursue a useful activity is roughly constant or changes very slowly, and job qualifications, except of course in the event of co-ordinated large-scale training projects, fluctuate little over time.

It will be noted that the mobility of workers in private enterprise is more theoretical than real, as attested by recent difficulties encountered in France when it became necessary to convert to new activities.

Thus a major constraint in basic and advanced training lies in the continued presence of staff, whether at national scale, in the large Government concerns or in private firms. This general trait of employment makes it easier to show why continuous training is so urgently needed.

The role of technical progress

Such a need mainly arises as a result of technical progress, aptly illustrated by two French State enterprises generally regarded extremely stable.

In 1945, gas was distilled from coal, whereas now the industry mainly consists in conveying natural gas through pipelines. Yet the same engineering and supervisory staff are employed. Electricity was thermally generated in 1945 by semi-automatic systems of less than 100 MW, and before 1970 the work will be done by fully automatic 600 MW systems.

These examples are taken from industry, but others can be found in business administration, such as the electronic processing of customers' accounts in banks and insurance companies. Agriculture may provide an even more striking example, owing to the rapid changes in crop methods, breeding techniques and rural living conditions.

In modern industrialised nations, operating and management methods have been automated in all sorts of activities. In view of this very rapid trend, the knowledge of scientific and technical personnel must be constantly updated, not only in the secondary and tertiary sectors but in the agricultural sector.

Professional sclerosis, a serious complaint

In view of the need to keep pace with technical change, efforts should be made to avoid as far as possible a complaint we may describe as "professional sclerosis". In view of the extent of communications between regions and countries, no given firm or country can afford to maintain its technical and scientific capacity at a constant level. Private firms would be eliminated by international competition, while the State would fail in its major obligations towards its citizenship.

One of the main characteristics of the times in which we live is the extraordinary development of communication and information facilities. Men travel and ideas spread perhaps even faster, so that some new discovery or technique cannot long remain unknown to the world at large, even if its authors wish to keep it secret. If the invention is a fundamental one, scientists will want to use it. If it is one that will lighten the burden of toil and bring greater freedom, leisure or peace, men will come to need it more and more. It would be impossible, nay inconceivable, for an industrial country to process its products in such a way that the goods provided by and the services expected from the State failed to match, at least fairly closely, those supplied to the population in countries with comparable economic and technical standards. No developed State can today be excused for deliberately lagging behind the rest of the world where general technological growth is concerned.

The danger of inadequate training for qualified staff

The insufficient training of qualified staff is another urgent justification for continuous training.

There are serious weaknesses in the present training systems. There are no sufficiently comprehensive courses for technicians in economics, accounting and industrial management. In the administrative or literary fields, pure and applied science is virgin territory. Regardless of the type of school, systems of science education may [illegible] naid to dispense deliberately with general and economi[illegible] dministrative training to neglect the basic scientific knowle[illegible] st have in these times. The job of the technician or administrator is such that he must keep constantly up to date, and compels him to acquire vitally needed information from any and all available sources, most of which prove to be unsuitable.

Outdating of knowledge

This initial setback is aggravated for staff in employment by the fact that their knowledge inevitably grows out of date. Requisite training should be provided by management, but as it is usually busy with day-to-day problems, it cannot discharge this essential part of its mission. It is thus essential that ways be found for firms to organise training on their own or make some substitute arrangement.

Other reasons could be discussed, but all in some degree relate to those just described. One far from unimportant factor must however be mentioned: the fact that action is indispensable for workers to be upgraded.

The firm as the place and source of upgrading

In the present stage of intellectual and social development in our societies, there is one major argument for continuous training. A goal increasingly accepted regarded as a necessity and insisted upon by the ultimate recipients is that each man as an individual should be provided by society with every cultural and educational facility for so developing his own knowledge and occupational skills that his natural capacities can be used to the full. This need for upgrading scientific and technical personnel in industry is one of the main reasons for sponsoring basic and advanced training schemes.

B. Obstacles and difficulties in continuous training

Despite such evident needs, the organisation of large-scale training facilities by public or private enterprise, or organised bodies, meets with considerable resistance.

The unawareness as to change

One of the main obstacles is the fact that men, engrossed in their daily routine and oblivious to all but their immediate surroundings, lack the detached attitude which would allow them to take an objective view and thus realise that current trends affect their own particular profession. Man is usually aware of technical or social changes in spheres far removed from his own, but is less apt to feel personally involved until they reach the critical stage.

In view of this attitude it is very often difficult to introduce training schemes, since the parties concerned usually think that while others may need it, they never do themselves.

Satisfaction with the existing state of affairs

Resistance to training takes many other forms.

It may simply be due to the feeling of well-being and security that comes from familiar surroundings. This feeling of security causes any change in existing patterns to be rejected, a more frequent motive for resistance than might be supposed. Man today is caught up in a whirl of conflicting impressions; the radio, television, newspapers and cinema pelt him with words, he is dazed by a stream of publicity, his children live at a pace which he can ill understand, and a feeling of deep anxiety takes hold of him. Since he can no longer find in his particular neighbourhood - which he no longer feels he belongs to - or with his friends, whom he no longer has time to see, the stability that every man needs, he tends to look for it in his work, and tries to shape his job into a set pattern, something he can hold onto.

Again, it may be the profound conviction, resulting from a bookish type of education, that he has acquired enough knowledge from the start

to "practise his profession" for the rest of his life. This of course was true a few decades ago, and in France at least the traditions of the "Grandes Ecoles" may incline certain graduate engineers, after successfully practising for a considerable period without any appreciable change in knowledge or habits, towards the belief that such a state of affairs can continue for indefinitely.

Lack of time and financial difficulties

Some may also consider that the daily claims of the job leave no time for training which is to be useful in the future; this is one of the arguments most often encountered by the trainer in industry. As in the previous cases mentioned, many not necessarily unfounded arguments are behing such a motive. The operating difficulties of firms faced with ever-growing international competition, and action by management to increase productivity lead to considerable reductions in the labour force. In these circumstances firms are little inclined to allow part of their employees' working hours to be spent on training of a basic or advanced kind. The worker himself, who has to spend more and more time commuting and quite naturally wants time for leisure activities, is increasingly averse to training outside working hours, even though he may realise the urgency and need for such an effort.

It may also be argued that the financial resources of the firm, community organisations or the State should be used for more urgent tasks than the development of usually expensive schemes, whose overriding importance is masked by the considerations mentioned above.

Resistance to change

More basically still, some heads of firms have come to realise that training, by improving men's knowledge of new techniques or promoting their individual advancement, is a powerful source of change in structures and modes of living, yet refuse to plan for any such necessary trend, since it means that they must revise their ideas, behaviour and personal attitudes, as well as replan the organisation or administration of the concerns they manage.

Whatever the dominant reason among those described, it must be realised that training is very often rejected by the individual himself. While a little thought would appear to indicate that technical change, the need for comparable products as between enterprises or States, and individual advancement are reasons enough for providing all possible facilities for furthering knowledge or the reappraisal of behaviour patterns and attitudes, nothing could be less clearly recognised than this urgent necessity.

Teaching difficulties

At this juncture, various difficulties of quite another kind must be described: those relating to teaching itself.

But first, just what is teaching?

The art of teaching, contrary to other views, to our mind is much more than a technique. The fact that it applies to man-kind and is in some respects one of the most effective mediums for modifying their knowledge, that it will cause them to change their behaviour and attitudes, that it can induce them to revise their processes of thought, is evidence enough that it cannot merely be regarded as a technique. Is it a science? Only so far as it involves a knowledge of techniques and methods. It is indeed such a difficult concept to define that to make matterns clearer let us try to ascertain its purpose, and assume that it consists in developing and applying a doctrine of education, one which is both theoretical and practical and which covers all human activity. It must enable man, who is its object, to fulfil some of the purposes for which he is intended. It is impossible to talk of teaching without some definite concept of man and of his existence as a social animal. Yet whenever education applies to one technique alone, manifestly the connection between teaching and man as a member of society seems to be less necessary. If the man is learning some job motion or operating technique, such a question may appear superfluous. But the renewal of knowledge, refresher courses and the training of adults consist in learning more than some movement or technique. Here an effort must be made to imp[illegible] all the information required to practise a trade and develop adaptability. The vastness of such a task is proof enough that the question must indeed be asked.

In this field, we are all largely influenced, and quite normally, by such a concern as the training of children and young people; for centuries teaching consisted solely in a search for the best methods which would provide the knowledge enabling people to ply a trade for the rest of their lives. As knowledge, facilities and methods changed little, this initial training and personal research largely sufficed to solve most problems which arose during working life. This, however, is no longer true, and the younger generations are more aware of this problem than their forebears. Yet the teaching problem, in the sense that one individual we shall call the trainer should succeed in imparting a certain set of facts to another we shall call the trainee, varies considerably according to whether the latter is an adult, an adolescent or [illegible]

Setting aside general training [illegible] mind and character, and considering training if possible from a purely occupational aspect, adolescents may usually be said to have no knowledge relevant to their future occupation, and the trainer, as it were, has a clear field before him. He need only impart facts; whereas in the case of adults of whatever rank in the hierarchy, the number of years they have spent in their jobs has enabled them to make a personal synthesis of their knowledge as applied to the practical examples they have encountered. It is indispensable to make use of this experience, and draw from it all that may be of value or in keeping with the working methods that are taught, but each trainee must also be induced to change any bad habits or working methods. The trainer must help these adults to compare their personal experience, so that each participant may benefit from that gained by the other members of the group, measure his own experience against that of his colleagues and, in the light of its diversity, be more willing to alter his own behaviour or working methods.

The aim of the trainer is not only to impart a technique but to stimulate personal constructive thought about the job.

The scope of action of the trainer

Such a personal job approach at all skill levels raises a number of problems for the training authority.

Training taken in this broad sense no longer means the acquisition of some knack or special knowledge, but can and must lead to such a change of attitude and behaviour as will deeply commit the individual. The sensible trainer is compelled to recognise that even training of an operative kind will have short or long-term consequences such as: how the worker will fit some skill or laboratory technique, however complex it may be, into a sequence of operations, and how he will change the skill or technique that he was taught to regard as the only possible procedure. The trainer can never remain totally indifferent to such consequences, but which, just as a teacher dealing with children or young people, he must, sometimes, allow for and sometimes not, depending on the human concept.

Training within the firm – its ambiguities

In view of the environmental impact on training and its direct or indirect effects, the trainer in industry must try to answer a number of questions. It is thus not only normal but necessary to consider which subjects should be taught within the firm and which outside; to determine whether further training should be confined to a particular trade or include cultural subjects, and what would be the logical or desirable scope of training in the light of constraints imposed by new techniques or facilities. Other questions also need answering. When in a particular field the firm has defined a specific doctrine, what kind of training should be given and how far should it go? Must the [illegible] free to attend any training [illegible] they like? What degree of compulsion is the management [illegible] entitled to use when it thinks that a particular member of its staff should receive a special kind of training in the interests of his department? A final problem all trainers are faced with is the need to be neutral in economic, political and even philosophical subjects. And although we have taken the case of the trainer in industry for the sake of argument, we feel this to be true for all adult training whether in trade unions, the family, community, recreation, etc.

The part played by the firm and the individual

Competence is primarily a personal quality, and the individual cannot expect the firm to provide him during working hours with everything he needs to carry out his duties – particularly senior personnel. This is because it is difficult to draw any sharp line between a man's job and his other occupations, and because it is inconceivable that a man should exist only to work. The ability he acquires to discharge his task – to the extent that training, as this paper attempts to show, is something more than the mere acquisition of formulas or reflexes – is useful to him in community, family and private life; conversely, the youth-club leader, the town councillor, the active member of a trade union or family association, or the representative of a parent/teacher association acquires in the

exercise of his "function" some measure of general proficiency which certainly helps him in his profession. This meshing of his activities into a single pattern should be a powerful inducement for the individual to regard his vocational training as his own private affair rather than that of the firm, trade union or community organisation concerned, depending on his activities of the moment.

On the other hand, the firm, whose broad function is to produce goods or render some service, is entitled to require that its personnel possess certain specific skills. It cannot, in my opinion, reproach its workers for lacking such skills without having somehow or other helped its staff to acquire them. It is right, therefore, that firms should take a close interest in training problems and in some instances set up actual schools.

The role of the State

This will be discussed at greater length in the conclusion, but the distinction between personal demands and those of the particular firm or community organisation will require a great many effective measures so that the citizen can make this personal contribution to his training. These are undeniably a matter for the State.

C. The need for personal effort

A difficulty of another sort also exists: the personal effort that training calls for. Regardless of how much assistance is provided by the State, the urgency of which we have just noted, clearly no one can take the individual's place in making the effort of understanding, memory, organisation and accuracy required to learn new facts. However gifted the trainer, nothing can dispense the student, or for that matter the trainer, from personal effort.

This need for personal effort is one now apt to be glossed over.

The "teaching-aid salesmen", training agencies and workers' organisations, in claiming the benefits of learning and culture for their members, unfortunately are only too ready to propose, inform or demand without regard for this need.

It is wrong to believe, assert or imply that knowledge can be acquired without trouble; no one can become a specialist in electronics without effort, just as no one can learn a language by reading novels.

The process of acquiring knowledge means hard work, no matter how adequate the teaching methods are, and although the methods used can help reduce the amount of work, if they rationalise the process, they cannot replace the effort of:

- Memory: the vocabulary is difficult to learn, technical rules are not easy to grasp, and to become familiar with technology requires long practice;
- Understanding: to understand the basic theorems of applied mathematics or science, the laws of economics and organisation and

management requirements, long and sustained application is needed. Nor are psychology and sociology subjects for amateurs.

- Willpower and perseverance: it is more tempting to "consume" leisure than knuckle down to the sort of effort described above.

It is no more than simple intellectual honesty to insist on this point.

There is a further requirement that should be mentioned: every member of the executive, scientific and technical grades in our industrial society of the latter half of the twentieth century has a personal duty to keep abreast of new knowledge.

We said earlier that the firm must help and enable its employees to acquire knowledge and information, but in exchange, these must regard updating their knowledge, in order to perform their job properly, as a personal obligation. Some may think, despite the assistance offered by the firm, that they have no obligation to keep their knowledge up to date.

If as a result of technical progress they are no longer able to do their jobs satisfactorily, it should be considered normal that, as an ultimate resort, they be d'smissed. This may seem to be an extreme solution, but one we feel deserves careful consideration before it is criticised.

The personal effort required however should draw our attention to the research to be done to find out what needs really are.

The basic or advanced individual training facilities set up must cover more than the technical, practical or technological aspects, since the problem is one which is much wider and different in scope. The first step must be to assess actual human and occupational requirements. Furthermore, apparent incapacity in some job may often simply arise from an inability to communicate or make oneself understood. It is sometimes necessary to learn how to listen to the other person, whether a customer, subordinate or superior, so as to find out what he wants and then react or behave accordingly. To discover and develop a common language and an effective, thorough method of communicating with people is essential, whether on the technical, economic, artistic or cultural plane.

But the necessary facilities can be made available neither at firm, regional or national level unless an active minority has recognised such a need.

II. Specific Achievements

Basic and advanced staff training at Electricité de France and Gaz de France

These questions are, as we are well aware, of major importance, and it may be useful to describe what two French nationalised industries, Electricité de France and Gaz de France, have achieved in this connection - the stage ideas and actions have reached and the difficulties encountered.

As these are large nationalised enterprises, it may be well to recall that under the Nationalisation Act these Authorities are not only public services but are under a certain obligation to participate in joint training for promotion activities and establish new working relations between their staff members. The effectiveness, and especially the method of compliance with the law's intention may be open to question, but the fact remains that all responsible senior officials of the Authorities must continuously bear this intention in mind. Moreover, a number of statutory provisions have enabled the staff to give effect to such joint or individual advancement schemes. This obligation unquestionably makes it easier to set up extensive initial and further training facilities, and creates an atmosphere more conducive to training and upgrading activities than is generally found elsewhere. Because of this while the obstacles described above do exist, they are undoubtedly less difficult to overcome.

It is important to remember that Electricité de France and Gaz de France now employ almost 120,000 workers on a statutory basis, broken down as follows: 11,000 in the executive and engineering grades, 34,000 in the supervisory grades and 75,000 operative staff.

The executive and engineering grades are graduates from engineering schools or higher education, but also include others whose long practice of their trade and personal qualifications enable them to fill jobs normally assigned to qualified engineers, moreover, the percentage of engineers at this staff level is much the same as in most comparable firms: about one-half. The definition of supervisory staff ("agents de maîtrise") and operatives ("agent d'exécution") is that customarily used in the western countries, bearing in mind that foremen and charge hands are ranked as supervisory staff while junior administrative employees are classified as operatives. It should be noted that workers are mainly recruited in the operative or executive grades, since most of the supervisory posts are at present held by operatives who have been able, owing to their personal qualities and work and with the help of the various training schemes organised by the undertaking, to rise to higher posts. Such staff is extremely stable, and very few workers give notice or go to other jobs. The number of workers employed by the Authorities increases by about 1.5 per cent every year; it may be interesting to compare this figure with the rate of increase in services provided by the concerns which amounts to some 7.5 per cent per year.

A recent study, which takes account of the present age of workers and the low departure rate just mentioned, shows that almost two fifths of the staff who will be working in 1985 are already employed in the Units or Services, provided no major changes take place in present structures or practices.

These few statistics and the information on how staff are recruited indicate the amount of effort needed concerning basic and advances training activities if workers are to continue to be able under increasingly stable conditions to render the services which the public is entitled to expect from the Authorities.

Basic and advanced training

The need for both basic and advanced training has always been felt in both industries. One of the Refresher Course Centres now operating, i.e. that of Nanterre, was created in 1938, while most of the present Training Schools for workmen and charge-hands were set up in 1942, but these were comparatively isolated and unco-ordinated efforts, and only after the industries were nationalised (1946) was the true importance of initial and advanced training properly understood or became the subject for major decisions, careful thought and considerable effort. One result was the creation of a specialised training division attached to the General Secretariat, the PROFOR Department (Promotion Ouvrière Formation et Perfectionnement du Personnel Organisation), whose task mainly consists in proposing to General Management decisions governing the policy, doctrine and objectives of both Authorities in the field of promotion and training. Once a decision has been taken, the Department is responsible for putting it into effect, particularly in drawing up sillabuses and in choosing and applying training methods and procedures. PROFOR also obtains from general Management information that will enable the training centres and establishments for which it is responsible to carry out their work as effectively as possible. The human and material training resources thus created allow the Authorities to organise for their own benefit from both technical and administrative aspects, all the courses and classes they consider useful for the training of their staff.

An equally important advantage is that all workers who so wish and who have the necessary ability can acquire the additional knowledge and training needed to carry out their duties with greater efficiency or to qualify, under the rules in force and consistently with sound management principles, for jobs at all grade levels in the system.

The training authorities obviously try to achieve both these objectives, and one fortunate aspect is that, as the same people and the same means are concerned, the action undertaken to achieve one of these objectives makes it possible to approach or attain the other.

This approach is not entirely consistent, however, and gives much food for thought. The heads of the PROFOR Department try to reconcile operating needs as defined by the managing authority with individual needs as expressed directly or through staff representatives. As a practical solution to these problems, the training authorities have set up a certain number of rules, as follows:

- The employee's attendance at a course must be voluntary. Although in some cases (correspondence courses, the refresher scheme known as "Promotion Sociale") this is all that is required, management being simply informed of the training taking place, in others the workers must have permission from their unit head (practical training preparatory to an examination, for example) or be designated by their division after consultation with the joint management/labour committees (e.g. for training courses in a school).
- Courses may take place during or outside working hours, or during a combination of both, having regard, of course, for the needs of the service; training is always free. Remuneration continues throughout the length of the course, and additional expenses

incurred are reimbursed, such as travel, living and other miscellaneous expenses.

- The internal institution known as "Promotion Ouvrière" (Worker Training for Promotion) is the only type of training which systematically leads to promotion. But all the other training courses also offer workers a better chance to rise in the ranks.
- The staff representatives are always consulted on the action undertaken. To this effect, the training objectives, the specific syllabuses and even the training methods are examined by a joint subcommittee (Sous-Commission de la Formation Professionnelle), a branch of the 'Commission Supérieure Nationale du Personnel'.
- The training is so arranged that each step is complete in itself, or part of a whole. It thus tends to match the hierarchy on the industrial side, and many steps correspond to the job grades. This type of training covering the whole job hierarchy enables each worker to begin at his own skill level and move up to any level commensurate with his ability.

This, then, briefly describes training goals and the rules adopted to achieve them. A number of problems closely connected with the views of the top management of both Authorities concerning training and the part it should play and the relative importance of the needs of the service and the individual. But it should be remembered that neither Authority is a university institution, and that personal training, however important, is not its primary concern.

The training systems in force

Some of the activities undertaken go beyond the already considerable province covered by both Authorities and correspond in fact to a general scheme for the benefit of the whole country, and showing, if this were necessary, the constant dovetailing of ideas and achievements in the educational sphere. The leading activities are as follows:

1. Training of young workers

The French laws governing the practical aspects of vocational training for apprentices and young people place the vocational schools created by these two establishments into the category of "Ecoles de Métiers" (Trade Schools). Students who are recruited by means of a nationwide competitive examination at a level corresponding to the end of the first cycle of general secondary education, are between 17 and 19 years old. Successful candidates are admitted as boarders at the same financial rates as pupils in the Departemental "Lycées techniques". Tuition is free, and scholarships may be granted by the State. Training takes from one to two years, depending on the educational background of the students, their marks during the course, and the branch chosen. The schools in question are State educational establishments, the staff in charge accepting full responsibility. General subjects are taught by State-appointed teachers of the Education Nationale, and Headmasters are appointed by

the Ministry on the proposal of the Authorities. Training covers the vocational, physical and human aspects, the latter to the student aware of responsibility closely associating him in maintaining discipline, planning leisure and cultural activities, and administering the schools.

On completing his studies the student is usually given a job by either one of the Authorities, the course having specifically prepared him to perform certain tasks in these industries. He is not obliged to accept recruitment, and is free to pursue a career in any other sort of enterprise. Actually the great majority elect to stay. The fact remains that the industry has, in accordance with French law, assumed responsibility for much of the training of a segment of the school population.

The schools as a whole train about 1,000 specialists every year, and are attended by some 1,500 to 1,600 pupils.

2. Further technical training

The aim is to update and improve the worker's technical knowledge of his trade and, to a less degree, his general education, allowing him to keep pace with changes in equipment and working methods.

At present this type of advanced training is given in the Nanterre Centre, and in the Trade Schools at Gurcy-le-Châtel, La Pérollière, Soissons-Cuffies, Versailles et Lyon-la-Mouche, in the form of "specialised training courses" organised at the request of the various Services. Their length varies according to the type of training, and use is made of experimental teaching methods calling for extensive student participation and appropriate audio-visual equipment. Certain short courses are devoted to specific types of practical knowledge and job motions. Others, which last three months or more, prepare workers for various jobs, frequently at a higher level than their own. The workers who attend are selected by the Heads of their Units after consultation with the appropriate "Commissions Secondaires" (1). At present about 40 separate skills are being taught to over 2,000 workers a year. The Training Services frequently organise further courses for new skills at the request of the technical departments concerned.

3. General and vocational correspondence courses

These are available to all workers who wish to improve their general knowledge. Such courses are purely optional and study usually takes place outside working hours. The following subjects are covered: French, mathematics, electricity, electronics, technology of electricity and project drawing, physics, chemistry, technology of gas and project drawing.

Special vocational courses are also arranged for administrative and accounting personnel.

Correspondence courses were extended in 1964 to over 6,000 workers (technicians and administrative workers) who were thus able to prepare under optimum conditions for:

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(1) Joint advisory committees for all personnel questions.

- various trade certificates "brevets professionnels" (electricity, gas);
- a CAP (Trade Proficiency Certificate) (electrical fitters, electrical engineers, gas-workers in the External Services or gas men and gas fitters);
- specialised further training in the Trade Schools and the Training centres;
- intelligence tests organised by the "Promotion Ouvrière";
- evening courses organised by the Conservatoire National des Arts et Métiers and allied centres.

Workers who pass the Promotion Ouvrière intelligence tests follow correspondence courses with the "Ecole chez Soi" (Home Tuition) branch of the ESTP (1) to prepare them for admittance by examination to the "Promotion Ouvrière" 1st or 2nd degree courses.

In addition, special training courses are arranged by various Units, often in the framework of the "Promotion du Travail" (Occupational Advancement Scheme) in conjunction with the Education Nationale. These courses often continue and supplement various correspondence courses. Particular mention should be made of the oral teaching sessions and coaching given on the sport to workers following correspondence courses in preparation for the "Promotion Ouvrière" entrance examinations.

4. Refresher courses for workers

These courses are halfway between the two types of training mentioned above, and take place partly in working and partly in leisure time.

These courses, which are given locally in the Operating Services and are open to administrative or technical staff, consist in developing, in concrete form, such specific subjects as electric water-heaters on the storage principle, gas water-heaters, fluorescent lighting, cuts in electric current, transformers, electric motors, gas combustion, etc. Employees are able to learn more about various basic techniques connected with their trade than they normally have occasion to use or learn about when doing their job.

Instructors are generally engineers who are of higher rank than the students and have attended teacher-training courses at the Ecole Nationale de Métiers of Gurcy-le-Châtel.

The courses, which are always based on physical phenomena, are abundantly illustrated by experiments, apparatus, models, films, etc.

At present 24 different subjects are being taught; in the Thermal Generation Service, they come under regular staff training courses. The engineers alternate them with theoretical subjects, for which they often serve as practical examples.

One of the responsibilities of the Centre d'Etudes et d'Application Pédagogiques set up in Gurcy-le-Châtel is the study and preparation of

(1) See p. 303.

all documentary material, equipment and films required for each training session.

This type of training has developed considerably since it was set up in 1952, and 30,000 members of the Electricité de France and Gaz de France staff now take the courses held in most of the Services.

The staff instructors, of whom there are about 760, now have over 1,000 sets of teaching aids, including written material, index cards, demontration equipment, wall charts, etc. These sete were devised by the Ecoles de Métiers, under the supervision of the Centre d'Etudes et d'Application Pédagogiques of Gurcy-le-Châtel.

The scheme for the improvement of workers' background knowledge, which has met with great success, has proved to be a reliable and efficient way of uncovering the talents of operative staff scattered throughout the country, and provides effective leverage for the "Promotion Ouvrière" scheme taken in its widest sense.

5. Local training groups

Training on the job is required in most cases. There can be no question of sending all the supervisory, operative and clerical staff of the Electricité de France and Gaz de France to the Training Schools and Centres: while this is possible, as we have already seen, for some skills, it is during their daily activities that most workers - and this is one of the major responsibilities of the workers' direct supervisors - are able to improve their skills, organise their work to better effect and learn new technical processes.

The purpose of the decentralised action taken by the PROFOR Department is to promote at regional level the best ways of meeting training needs as defined by management and the staff. As a result of these measures, "Local Training Groups" are being set up.

The courses already organised in this field (Regional Distribution Headquarters of Tours, Bordeaux and Toulouse) satisfy a number of criteria: Training programmes are adapted to local requiremente and co-ordinated with other training arrangemente made at national level by Electricité de France and Gaz de France.

The teaching methods used by the "Local Training Groups" are as active as possible: no more than ten students ever attend a course in each group, thus promoting exchanges of experience by means of practical exercises and the discussion of the job problems encountered by the various categories of employees.

These refresher courses are make it possible to reach all the workers from a Unit in the types of job covered by the syllabus.

The instructors, who are recruited from the senior grades in the Unit and trained as teachers by the PROFOR Department, draw considerable professional benefit from their teaching activities, which also afford opportunities for cultivating more meaningful human relationships.

6. "Promotion ouvrière" (Worker Training Scheme)

The "Promotion Ouvrière" (PO) is the instrument through which Electricité de France and Gaz de France can give able supervisory or

operative staff of either sex an opportunity to rise fairly quickly to executive posts through a carefully worked-out process of selection and training. For this purpose the PROFOR Department has an Instruction Centre at Asnières and is assisted by the Ecole Spéciale des Travaux Publics in Paris. Since 1948, over 1,000 workers from both establishments have been able to obtain jobs as senior technicians or administrators. Up till 1948, workers who volunteered for training followed correspondence courses at one or more levels according to their educational attainments, determined by an intelligence test, before taking the examination admitting them to the "Promotion Ouvrière" scheme. Training consisted of two years of full-time study at the ESTP, one and a half months in-service training every year, and a six-month trial period before assignment as junior executives ("Jeunes Cadres").

Experience brought to light various disadvantages:

- Some workers and employees had serious difficulties in completing the preliminary correspondence courses;
- Unsuccessful candidates were not moved from the job they held in their particular department, although many were capable of filling supervisory posts and had acquired additional knowledge.

To remedy this situation, "Promotion Ouvrière" was reformed in 1958, so as to:

- make the scheme more accessible to staff with little theoretical knowledge to begin with by replacing part of the preliminary training, previously given by correspondence, by full-time school training. An extra year of study was arranged (PO 1st degree) during which instruction is designed to bring the general and technical knowledge acquired by workers from very different backgrounds up to a common standard, and to develop their critical faculties and capacity for observation. On completing this year of study, students sit the entrance examination for the 2nd degree PO courses, given as before at the Ecole Spéciale des Travaux Publics.
- make supervisory jobs available to staff who have satisfactorily completed the 1st degree PO course but who have not been admitted to the 2nd degree course. Such personnel follow specialised training courses for supervisors in a National Trade School or at the Nanterre Centre, depending on personal aptitudes, in a branch carefully selected from among the twenty existing skills.

They then attend a final practical "supervisory" course before being assigned to a particular department. The courses and training period last nine months in all.

- organise training with better regard for present departmental requirements.

The "Promotion Ouvrière" scheme is open to all permanent staff, subject to the following conditions:

- a so-called "screening" test is compulsory for workers up to category 6 before they can follow the correspondence courses. It takes place during the first quarter of every year.

Candidates must not be over 40 years of age and must have completed at least two full years of actual service in the EDF or GDF.

The admission to the 1st degree courses fo vs an examination open to those who have regularly and profitably ved the special correspondence courses, to those who have alread been classified in categories 7, 8 and 9, and to those who, after scr ening, are authorised to sit the entrance examination to the 1st degree course in the same year. Candidates must be at least 22 and no more than 42 years of age and have completed three full years of service with the EDF and GDF.

The "Promotion Ouvrière" has two branches:

(i) A "technical" branch;

(ii) An "administrative" branch.

The technical branch

The correspondence courses cover the following subjects: French, mathematics and engineering, physics and chemistry, engineering drawing.

The 1st degree courses consist of general and practical training based on general technology, engineering drawing and handling of equipment. The 2nd degree courses consist of one year of general study and one year of specialisation. The worker can choose between four sections: Electricity production and transport, gas production and transport, distribution of gas and electricity, civil engineering.

The Administrative branch

The correspondence courses cover the following subjects: French, law, economic geography, mathematics.

The 1st degree courses offer general and specialised training: accounting, commercial law and economics.

The 2nd degree courses take two years: the first year is devoted to general knowledge and law, and the second year to general accounting subjects and administrative and commercial methods used by the EDF and GDF.

7. Teacher-training research

Another series of activities which at first was very closely geared to the needs of both State undertakings has gradually been made available not only to the whole of France but, through the Ministry of Foreign Affairs and the Ministry of Co-operation, to many foreign countries. This consists of research into and the application of active methods and techniques in teaching electricity and electrical engineering. In particular, methods of adult vocational training were carefully studied.

Research covers general teaching methods for adults, regardless of skill level, but more particularly the ways and means of imparting an awareness of management and leadership problems. Research is supplemented by improvement to teaching equipment and audio-visual aids for teaching very advanced techniques and teacher and instructor training.

In view of the speed with which the techniques used by EDF and GDF change, the PROFOR Department decided to introduce extensive research facilities. These have led to the use of a number of teaching techniques, experiments in the development and use of teamwork, an awareness and need for constant self-appraisal in job performance and for determining the key components of a task and their relation to each other in as rational a manner as possible. Considerable experimental equipment is used, so that a step-by-step approach can be made to practical working conditions. The theoretical knowledge required to understand job motions is not approached from the mathematical angle, but from that of its practical effects and physical manifestations.

8. Training of executive grades

The training of senior staff is based on recent psychosociological research. The personal consideration such staff must give to problems of communication between individuals and to the effective use of meetings, or to methods and factors in decision-making, is facilitated by discussion in small groups on subjects suggested by the instructor. This training is completed by various contributions on the part of the teacher and which bring the participants face to face with the types of problems they meet in their professional life.

The main forms of training are:

(i) Reception and initial instruction of junior executive staff

When junior executives are engaged they undertake a year's statutory training, during which they take part in conferences and visits so as to become familiar with problems peculiar to the Authority. In particular, training courses in technological subjects of two to six weeks are arranged in one of the Trade Schools.

Four types of training courses may be mentioned:

- "Electricity" courses covering technological and practical aspects (for junior technical staff); these last six weeks and take place in the Trade School at Soissons-Cuffies;
- "Gas" courses dealing with similar technological and practical aspects for the junior technical grades; these last three weeks and are given at the Lyon-la-Mouche School;
- Technical introductory courses in electricity (for junior administrative staff). These last two weeks, and are held at the Centre de perfectionnement électrique of Nanterre;
- Similar courses in gas technology for young administrators, for one week at the Ecole nationale de métiers of Versailles.

In addition, the EDF Production and Transport Division has arranged, in conjunction with the PROFOR Department, for a series of introductory briefing sessions to be given to junior executive staff.

These various activities, together with the time spent in actual job training, enable the young executive to get to know what his future job is about, and allows the particular recruiting Division to select the branch

for which he is best suited and to determine w[illegible]ther he can qualify [illegible]r permanent status on completing the required year of training.

(ii) Technical and technological knowledge

This training is organised by the divisions responsible for the [illegible]hnical quality of the services provided and for seeing that their staff h[illegible] [illegible]he knowledge required for the proper installation, use, maintenance and renewal of operating equipment. The PROFOR Department is kept in[illegible]ormed so that such activities are included under general training policy and so that its facilities may be used where appropriate.

Present activities include:

- training courses sponsored by the Commissariat à l'énergie atomique;
- briefing sessions organised by such Divisions as Distribution, Study and Research or General Economic Studies, for heads of the Electricity Technical Service and various executives in th[illegible] Operating Services;
- briefing sessions on gas organised by the Head of the Subdivision in the Trade School at Versailles;
- courses in electronics for engineers specialising in thermal generation at the School in Gurcy-le-Châtel;
- courses at the Ecole d'application des techniques gazières;
- courses at the Centre de perfectionnement commercial for staff employed on the commercial side;
- Ecole d'été d'analyse numérique.

(iii) General knowledge required for the exercise of a trade

It is now an accepted fact that the executive grades must have more than a knowledge of equipment and techniques, however sound this may be.

The growing complexity of the plaint and the increased number and importance of the technical and administrative links between the various parts of an industry mean that any decision taken by an executive in whatever field affect an ever-growing number of installations, services, employees and other decisions, and must be formulated in conjunction with other personnel at all levels.

This new situation means that the executive officer must have a vast fund of general information, learn to think farther ahead, and weigh with greater care the results of his decisions.

Scientific and technical progress is so rapid that the need for effective and constant adjustment has changed the very concept of further training: considered but a few years ago as a marginal activity for anyone with time on his hands, it is now regarded in its widest sense as an obligation which everyone must assume if he is not to be left behind. An executive who wishes to keep abreast of new facts must not only keep his knowledge up to date but relearn, rethink and perhaps entirely revise his fund of knowledge several times in the course of his life.

Present training activities designed to further such general knowledge for professional purposes include:

(a) Training courses arranged by agencies outside the Authorities

Courses in various centres, institutes and schools designed for the executive grades, such as:

- At the Institut Economique et Juridique de l'Energie (University of Grenoble), in conjunction with the French Coal Authority -- two weeks;
- At the Centre Scientifique et Technique du Bâtiment - about two months;
- Refresher courses lasting from two to three weeks at the Ecole Supérieure d'Electricité, and the Ecole Supérieure d'Aéronautique;
- Various training courses in conjunction with organisations providing basic or advanced general training and institutes of business administration.

Information on these courses, which the PROFOR Department either obtains directly or from various Divisions, Services or Units, is sent to all departments; staff is enrolled for the courses through the PROFOR Department.

Courses in economics and statistics lasting from two to three weeks following the same notification and enrolment procedure as for those described above, after consultation with the EDF's Service des Etudes Economiques Générales or the GDF's Direction des Services Economiques et Commerciaux for the disciplines concerned. These courses are at present organised for the benefit of staff with wide responsibilities who need a knowledge of economics to carry out their job.

Language training. These courses, which are now organised on EDF and GDF premises, have grown very rapidly. They were attended by almost 600 students during 1964.

In all these cases, permission is obtained from the employee's superiors, and expenses are paid by the Authorities.

If an employee enrols for a course on his own initiative, the PROFOR Department, on the proposal of the Division concerned, usually donates a sum of money by way of encouragement, upon presentation of the certificates or diplomas obtained.

(b) Training within the EDF and GDF

In 1954, the Management of the Electricité de France and Gaz de France opened a Training Centre at Cébazat (Puy-de-Dôme) for junior executives who had spent a few years in responsible positions. The general aim was to help the younger executives from the various regional offices and services to shoulder their responsibilities by showing them the importance in industry of human relations with their subordinates, colleagues, and superiors.

As the course subjects were designed to enable students to understand themselves, others and various situations, they should encourage the type of attitude towards research and discovery which is a prerequisite to further training. The course was a starting point for more regular forms of training, and a first stage in a cycle that would be repeated throughout working life.

It soon became apparent that, to be fully effective, the courses would have to be extended to as many executive grades as possible. It was thus decided in 1958 to open another Centre at Bréau-sans-Nappe, which catered for senior grades and subsequently for unit supervisors.

A new study Centre was opened in Bort-les-Orgues at the beginning of 1965.

The present courses are:

<u>Study of human relations</u>

These courses, which last two weeks are intended for staff who have spent a few years in highly responsible positions. They are attended by about 20 participants divided into two groups. The participants' expenses are fully assumed by the Centre.

The students participate in the lessons and lectures are kept to a strict minimum. It is essential that each student be left individual responsibility, choose his own means of expression, and formulate his own concepts in dealing with human problems.

The syllabus comprises classes of different types: teamwork; case studies; problem investigation; lectures by instructors to serve as a basis for discussion.

Such problems may be discussed as: teaching methods; teamwork methods.

<u>Seminars on internal communications and the preparation and formulation of decisions</u>

These are of special interest to staff responsible for a Service or Unit.

The length of the seminar is the same as at Cébazat, but the syllabus is divided up slightly differently. The part devoted to the study of problems is more developed and includes applications of the method proposed. Lectures are given by instructors on the following subjects: internal structure and communications; changes in the forms of authority; the decision-making process or operational research.

<u>Seminars on general organisation, management and accounting</u>

These began in 1961. They are based on the same teaching principles as the seminars conducted by the Cébazat and Bréau Centres, but are more especially intended for senior staff who have already spent time in the Centres and are familiar with teamwork and with "problem investigation". They are mainly concerned with:

- Organisation as a general concept and its practical applications;
- Management form the "decision-making" aspect with or without the assistance of electronic computation;
- Accounting as an instrument of management.

One or two lectures on investment are given by instructors during the course which ends with a general summing-up of the work done.

Introduction to the economic techniques of industrial management

This course began in 1963, and is intended for staff with important management responsibilities. Participants come into close contact with modern economic techniques which they then place against the background of major contemporary economic options.

Training in the techniques of oral expression is provided for executives who have to speak in public - whether frequently or on odd occasions - and covers both preparation and delivery. Participants learnt express their thoughts with greater ease, clarity, precision and effectiveness, particularly in technical lectures, during discussions, and on official or professional occasions. These seminars last one week.

In addition to the seminars described above intended for executive staff from all Divisions, the Department arranges others exclusively designed for some special Division or such national services as the Energy Transmission, Thermal Generation or Thermal Equipment Services.

(iv) Knowledge of the working environment

Technical and technological know-how is indispensable for the proper performance of the executive's job. An accurate assessment of the importance of communications and information, a readier grasp of the interdependent effects of decisions taken at every administrative and operational level, and the need to be correctly informed of technical processes in other departments and at other management levels are equally essential. But an understanding of the Authority's problems and of the business of the offices and agencies with which it is in contact is also highly desirable to ensure that the executives work is not dissociated from the general context. Present activities in this field include:

- The "Information des Cadres" Bulletin, which informs executives of the role and activities of the two Authorities, describes major technical trends, and discusses subjects of a general nature relating to each industry.

As of 31st December, 1964, 50 issues containing 163 articles had been published. "Information des Cadres" is now sent to all inactive executive personnel upon request, and the number of copies printed has accordingly been increased to 20,000.

- Seminars known as "Connaissances de l'établissement" (Getting to know the Firm), organised to provide a better reciprocal knowledge concerning practical problems in the various divisions, from the technical, economic and financial aspects. These are intended for top executives in the Authorities, and consist of general lectures on specific divisional problems by competent representatives of each division, followed by visits to factories and plant.

It is proposed to arrange seminars consisting of lectures and open discussion on general problems directly concerning the greater part of the operating staff, e.g.: local institutions decentralisation and regional economics; planning and its regional applications; town planning and its consequences.

Lastly, trips abroad for staff may be arranged by Management in conjunction with the IGECO (Inspection Générale pour la Coopération Hors Métropole), either on an individual basis, as members of missions in which other public or private establishments take part, or in an exchange capacity.

The EDF and GDF extend these facilities to many other undertakings of a similar nature and with similar concerns, both in France and abroad.

Training and methods of organisation

The work accomplished by the Authorities has strongly highlighted various ambiguities which may appear after training in view of the job to be done. In general, the training process would be unsuccessful if it were not aware of its own limitations, or lost sight of the interdependence of its own activities and such others as management, organisation or administration. Training imparts knowledge; it enables men to understand and control patterns of behaviour; to think and act in a way conducive to effective job performance; it can offer them certain resources so far as such means relate to the intellect or to action. On the other hand, training can never provide the material resources for performance. While this is largely self-evident, the following is much less so: in no circumstances can further training offer the statutory powers required for the knowledge acquired to be used; it is not and cannot be a legislative instrument for modifying administrative structures and regulations. The man who has been trained must strive for the best results within the framework of material and administrative constraints (as determined by his specific duties and a certain area of discretion, responsibility, etc.). This point is often wrongly understood. The view often prevails among trained men that society has become adjusted to their new-found knowledge and that they can make use of it. Thus training cannot be successful unless accompanied by a constant endeavour to match the opportunities offered by further intellectual attainments and those provided by organisation, equipment, and a definition of their particular area of responsibility and discretion.

Yet action taken as a result of further training is not altogether fruitless in this respect; it is able to afford a better insight into problems and also help men to regard any solutions proposed with a more open mind. It should here be borne in mind that the better informed and the more knowledgeable a man becomes, the more apt is he to feel personally involved in the search for solutions, hence his acceptance of change and progress will also depend on how much he is called upon to assist in formulating decisions which concern him.

III. Conclusions

In conclusion it may be said that the many measures required should be taken above all by private enterprise, public bodies, and by community organisations of all kinds, whether at worker, neighbourhood or city level, and in general by bodies associating men sharing common religious, philosophical, political or recreational interests. They would also come under the State, and in any case they may be said to be required in the three fields of information, education, and material and human resources.

Information

It is important that each community organisation and the State, each within its own sphere, should draw the attention of its members or citizens to the reasons warranting continuous training. While the people concerned should not be made to feel inferior, they must be motivated by a strong personal drive to update their knowledge and attitudes, and reappraise their living habits in a constantly changing world.

Such media as the press, radio and television should draw the public's attention to these needs, although without exaggerating the subject. But it is essential that such concerted action point out that much time, patience and effort will be needed for such new knowledge to be acquired.

Fields of study

Information is not sufficient, however. The various forms of resistance to change in this field, and the material, psychological and even philosophical reasons for resistance are not well known; nor are the means for dealing with it.

A system of regular surveys should be initiated, and regional and national confrontations organised in order that manpower requirements in agriculture, private or public enterprises, and in government administration may be evaluated as precisely as possible. These needs should be determined according to levels and types of skill. Information should be available regarding flows of young people at all skill levels, or of adults who have received further training. The data obtained should enable a balance to be struck between regional and national needs and resources at all levels.

This process, which was initiated for experimental purposes by the French Commissariat au Plan, should be extended and complemented.

In agriculture and industry a similar planning effort should be made for each branch, based on long-term development programmes and a quantitative and qualitative manpower policy.

And, still further, and going beyond the strict limits of scientific and technical personnel, in the spirit of the first part of this conclusion, requiring the existence of a "complete" man studies should also be undertaken in the area of each of the divisions of society we mentioned. In 1966, man cannot be regarded as a mere producer or consumer, but

as a more or less conscious or willing member of each of the bodies we described, all of which reserve to be studied.

Facilities and achievements

Once these needs have been determined, action must be co-ordinated as a whole, particularly concerning facilities and methods, and the examples of the two industries discussed above show that proposed research must be general in scope. The conditions required for training and adapting scientific and technical personnel are so numerous and imperative that experiments cannot be renewed too frequently. It is essential to provide forums where such experiences can be compared, perhaps first of all by occupations or main sectors of activity, but soon thereafter at national and international level. Lastly, it is important to set up pedagogical documentation, research and pilot centres with the object of defining and developing with all possible speed a general policy for adapting methods to different mentalities and needs.

In this connection, and without digressing too far, we can perhaps comment on the part to be played by the University. Should it be only the place for developing and communicating knowledge? Should it be no more than the means of promoting and propagating information? Should its professors and instructors be content simply to lecture? Should it be no more than the meeting place for men who have "something to say", who deal with the basic components of education, who think about teaching principles and techniques, or should it at all times also consists a "pedagogical service", that is, itself be the instrument through which knowledge is made available and transmitted, and which regulates the learning process?

It is quite clear that this will be its role in imparting the basic notions needed by every child or adolescent in the course of his schooling but apart from this teaching task, should it also be assigned the job of educating? Should it, in its present or future form, be directed by the family or by other social groups to train the men, citizens and students who are to share in the world's activities? Should it, for example, be allotted the task of initiating the student to community life, as by allowing him to share some part of school responsibilities, whether from the aspect of discipline, regulation of the learning process, or material classroom and boarding facilities?

Will it be no more than a "source of knowledge" where adults are concerned, or will it be no more than share the distribution of this knowledge with the leaders or members of different social groups, and will it be a leading associate and prime mover in all existing community groups? This is an important question, and one for which we believe a decision is needed in view of the strong danger of a "monopoly of ideas" and the grave consequences this would entail.

From a more immediate and practical angle, might not the assignment of such a heavy load to the University be detrimental to the quality of its service and mar its independence? Since it would be implicated, so to speak, in the material success of the various bodies and social groups receiving specific assistance, would it not thus become unduly involved in their everyday life, which is in fact a more or less acute but constant struggle? Would it not thus be compelled to run useless risks?

Yet the very success of teaching hinges on a confrontation with the facts; training in all its forms must develop alongside the world for which it is provided. Such a process of confrontation, evolution and awareness, and the adaptation of learning methods and changes of attitude to the realm of fact – the student by seeing how the information imparted can be assimilated so as to meet real needs, and the teacher by assessing the benefit derived by the student for a given social group from the "lessons" he teaches – these are what make the value of basic or re-training. In this respect, the connection between the University and industry, the community and leisure must apparently be a close and permanent one.

Are these two requirements totally irreconcilable? Actually, while some close contact with the various groups of society is necessary for its corporeal existence, the University should remain an outsider, as it were. But it should be available for assistance to these groups. In our industrial communities man must seek out his own equilibrum, and this can be achieved only by slow degrees, by constant, considered actions based on knowledge received from each of the social bodies to which he belongs. The mission of the University might be to inform, instruct and help all such groups in their education function. Its capacity for so doing will come from its availability and from incessant contact with the ideas formulated by all the social segments which go to make up our daily universe.

CONTINUING EDUCATION FOR ENGINEERS AND SCIENTISTS

by John K. Wolfe
(General Electric Co., USA)

I. Problems of Permanent Education

Introduction

Professional obsolescence is a highly personal disease, and the extent to which it can be avoided is largely a personal matter. The problems of obsolescence and re-training of technically trained individuals must, however, be examined from the viewpoints of industry and the national welfare as well as of individual engineers and scientists. All three are vitally concerned that adequate solutions be forthcoming. The increased complexity of the technical problems with which industry has to deal, together with the depth of training necessary to undertake them, poses new problems for industrial management.

One of the major questions with respect to the responsiveness of scientists and engineers to new conditions has to do with what has come to be called the knowledge explosion. Many observers have even expressed concern as to whether the teaching faculties of the universities are in fact responding sufficiently to the rapidly increased rate of change in the body of knowledge itself. It is more true than ever before that new knowledge will soon make existing knowledge and existing specialized skills inadequate and obsolete.

Individuals at various levels and in particular fields will have differing rates of prospective obsolescence. Professor Theodore Schultz (University of Chicago) has suggested the following order of decreasing obsolescence:

1. Vocational and job skills;
2. Knowledge of principles and theories;
3. Ability to solve problems and develop analytical tools;
4. Ability to keep on learning.

Vocational skills will be made most rapidly obsolete by the advances in science and technology and even the principles of science which are now accepted are undergoing correction and change more rapidly than ever before. It is only problem-solving ability, and the capability to go on with one's education that will be least subject to obsolescence and most useful throughout life.

The most useful and durable basic skills derived from a liberal or general education appear to be the ability:

- to perceive problems and solve them;
- to understand people, communicate and deal with them;
- to organize and structure data into an orderly pattern;
- to utilize one's own time in the most effective manner.

From the standpoint of the individual engineer and scientist, about 20 per cent of his time must be spent in re-training to maintain a constant level of competency. This estimate is based on approximations of new-knowledge generation at about 10 per cent year, coupled with a loss of unused knowledge (also about 10 per cent per year). With increasing amounts of the gross national product directed to research and development, the national interest demands increased effectiveness per man.

Since the largest segment of engineers and scientists is employed in industry and the salaries of these employees make up the largest segment of a research and development costs, industry must examine all methods to make technical employees more effective. Continuing education provides such a method, which is the more necessary because of manpower shortages in most engineering fields.

It is now well established that continuing education for professional engineers and scientists is a necessity for both the development of the individual and the sucessful operation of the technically oriented company. An unfortunate pattern for many professional people has involved a 5-10 year educational lag following industrial employment. When faced with this problem the engineer may have a very difficult time regaining his expertness. Over the past years science graduates un the United States have fared somewhat better than engineers, but now both groups appear fully alerted to the problem ahead. Electrical engineers, with their relatively sound background of science and mathematics and forward-looking curricula, have experienced more satisfactory adjustment to technological change than other fields of engineering.

Changing social involvement

Another important factor is the nature of the changing environment in which the scientist or engineer finds himself. Traditionally, he has been able to isolate individual problems, solve them and pass along solutions to others in the social structure for implementation. In our highly technical society, it is necessary for the professional technical man to go much further in implementing the solutions to problems as well as to consider the new problems he generates involving complex situations. Computers and automation represent typical examples of rapidly changing fields in which the engineer becomes heavily involved with several segments of society.

The nature of our technical problems is also changing. Instead of things yield to mathematical analysis and tests we are increasingly forced to consider people, political implications, social policies with many rules decadent in principle and outmoded. The engineer or scientist in automation, nuclear power, or air and water pollution, must, by necessity, involve himself with the impact of these problems on society. While the problems of the past have frequently been attached independently, present and future problems must be treated on a "Systems" or operations analysis basis.

Role of the technical societies

American engineering societies are becoming active in bringing this need to the attention of members. The Engineers Council for Professional Development (ECPD) has prepared a brochure entitled "The First Five Years" - a series of bulletins presenting facts and information with personal appraisal and motivation the key.

The programme prepared by the ECPD Committee offers an opportunity for employers, colleges, and the engineering societies to co-operate in making a definite contribution to the professional development of the engineer after graduation. For the guidance of young engineers and their counsellors, the following Six-Point Programme is suggested for consideration during the "First Five Years":

1. Orientation and Training in Industry;
2. Continued Education;
3. Integration into the Community;
4. Professional Identification;
5. Self-Appraisal;
6. Selected Reading.

It is essential at the outset to consider any personal programme in relation to the opportunities in each of these areas.

The Committee further states that any professional development programme must recognize three separate and distinct factors of community life which contribute to providing the favourable climate necessary for optimum professional growth. These are:

1. The industry-employer group;

2. Engineering societies;

3. The institutions of higher learning.

Each is related to several points of the programme, but the support of all three is needed for a well-rounded programme. The employer in particular has a special interest in the professional growth of the engineer. There is always a shortage of top-flight personnel. One important solution lies in bringing capable young men up through the organisation by helping them develop their capacities to the utmost. The greatest asset of any enterprise is its capable and well-trained people.

An active commission called the Advisory Council on Continuing Studies for Engineering Education has been formed. Under the chairmanship of Professor Ernst Weber, President of the Polytechnic Institute of Brooklyn, the group represents the Engineers' Council for Professional Development, the Engineers' Joint Council, the National Society of Professional Engineers, as well as the American Society for Engineering Education.

This Joint Advisory Committee on Continuing Engineering Studies was formed to examine the extent to which the major sectors of our technological economy believed in, or were planning for carrying out, new programmes for updating the technical knowledge of experienced engineers. An equally important charter to the committee was that of defining or refining a concept of continuing engineering studies that would utilize the strengths of four major "Task" areas (Industry, Government, Academic Institutions, and Engineering Societies) so each would supplement and reinforce rather than compete with the other.

Implicit within the committee report, such a concept does emerge. Glimpsed here is a new advance in learning, of such magnitude as to accommodate and require the best of professional educators, the most competent of industrial and government tutors, and the communications network of our well-organized engineering societies. Unlike traditional education, where each course is built up on its predecessor, independent self-sustaining modules of learning need to be developed. The presentation of this knowledge, in the classroom or via the teaching machine or through whatever mode is most suitable, will place extreme demands upon the teacher or course developer. He will now have to link the engineering theory of a decade ago with today's engineering science. He will also have to render understandable the increasingly complex new ideas, concepts, and methods of analysis and synthesis. And he will have to distil the true technical essence from burgeoning areas of engineering and science.

This new educational domain, involving men in their mid-career years, will raise questions of substantial release time, sabbatical leaves for selected industrial staff, the utilisation of our best engineering teachers to develop and teach new programmes during the summer months, and the creation and dissemination of tutorial material by the engineering societies.

A few of the problems mentioned but still unsolved include: motivation of the individual, the evaluation of both the teaching capacity of the programmes and the learning potential of participants and, finally, the

all-important question of cost. However, none of these is insurmountable if we become convinced that continuing engineering studies are essential for the future vitality of the profession.

Copies of the Joint Advisory Committee report are available now from the Engineering Council for Professional Development (ECPD) in New York City. Other technical societies have more specific programmes of continuing education with recommended courses of study in specific fields of interest. One of the most popular of such studies is the "Use of the Computer in Modern Engineering Practice".

Role of the Company

The role of industry in continuing education has been a more complex one. Many companies provide training courses for engineers to assist them to become familiar with industrial practice immediately upon graduation. Most of these courses have involved formal study, usually on the company site, with practical work experience in an industrial environment. Many of the larger more experienced firms have long-established company training courses for young engineering and science graduates, usually organized along functional lines serving engineering, manufacturing, marketing as well as installation and service. These courses fill a definite need in the educational process to ensure a smooth transition from the university to industry.

A recent trend has been for industry to help finance part-time study for the engineer or scientist after (and sometimes during) working hours in a nearby university, college, or technical institute. Some of these are referred to as "tuition-refund programmes" in which the engineer enrols in the nearby university of this choice, registers for the desired courses and pays his own tuition charges. Upon successful completion of the course requirements with a passing grade, the company will refund to him the cost of tuition and books. Some companies have paid for this tuition only upon completion of degree requirements. The incentive to complete the course satisfactorily is an important factor since larger percentages complete courses under this plan than under the earlier procedure of advancing tuition costs and expenses at the time of enrolment.

A recent survey showed that 80 per cent throughout of the American companies questioned have formal tuition-payment plans. Seventy-seven per cent insist that study be in ECPD-accredited schools. Participation by eligible employees in these university courses varies from company to company, with an average of 6-7 per cent being involved, the highest rate of participation being about 20 per cent. In my own company between 10 and 12 per cent of our engineers are involved in tuition-refund programmes, and about 25 per cent are involved an internal company courses. 36 per cent of our technical people are engaged in some kind of continuing course.

Role of the University

Basic questions have often been asked as to whether it is proper for the university to become involved with off-campus education. Indeed,

some have raised the question of whether the re-training of engineers and scientists is a university problem at all. While some of our universities have little or no participation in these programmes, the majority do have courses in which experienced engineers can participate. Some universities have fairly complete programmes in off-campus education. A most recent example is Northwestern University, which has published a leaflet giving the curricula available, specific courses and other information. It is a natural extension of their undergraduate co-operative programme (similar to the sandwich programme at British colleges of advanced technology).

Sabbatical leaves on the university campus for practising engineers in industry have been proposed as a solution, but the number of people concerned to date has been small and therefore the leaves have had little effect as a general solution. Scientists and engineers from industry are being used in increasing numbers to teach all or portions of university courses. Often these individuals have faculty appointments as lecturers or adjunct professors. The value to the educational institution is apparent and the individual adds to his own competency when he expands and updates his own knowledge preparatory to the teaching. In most such instances, the teacher learns as much or more than the student. A new programme has recently been started under the sponsorship of the Ford Foundation providing for a year's work in industry for university-faculty members giving knowledge of design and synthesis in an industrial environment.

Many universities have pointed their basic curriculum toward the development of continuing education as an accepted way of life. Institutions of higher learning must direct emphasis toward teaching students to learn rather than teaching them simply the results of what has been learned in the past. University departments, in many instances, accept responsibility to develop courses for periodically upgrading the engineer who has joined industry. Summer institutes for industrial engineers and university faculty are becoming increasingly popular. Usually of 6-8 weeks duration, these courses may be as short as two or as long as twelve weeks.

These special institutes and seminars assume a most important position in continuing education and their tremendous recent growth is most encouraging. Some selected examples are available in a folder. Illustrations selected at random are:

- Matrix calculus and numerical methods with applications to engineering systems (two-week courses);
- Ellipsometry for the measurement of thin films and surfaces (four-day course);
- Mass spectrometry, theory and application (five-day course);
- Corrosion control (three-day session);
- Optimization and stochastic models with applications (two-week course).

Summer positions in industry for students and faculty can [illegible] great help by providing a learning environment, particularly for particular skills in those fields where industry must have a rapid progress involving

heavy capital equipment investments - i.e., computers and information theory.

Continuing education for the technician needs much more attention than has recently been given. Since job skills become obsolete most rapidly, the need to maintain expertise in this sub-professional area is most urgent. Generally there has not been as much educational effort made for technicians as for professional engineers and scientists.

Management training

An additional role of the company has been to teach engineers and scientists the unique managerial skills particularly needed if the individual expects to move into the management of the business. The skills are usually divided into two categories. The first course is a highly technical one covering such particular skills as operation research, system analysis, decision theory and modern concepts of mathematics: all useful in the management of highly technical phases of business. The second is directed toward management skills working through people, devoting study to other business functions such as manufacturing, finance, sales, union relations, etc. These skills have been normally outside the educational scope of the engineer or scientist and can best be provided by the particular company involved. In my company, these courses are entitled "professional business management" and "advances management" courses.

In the first category, we have recently attempted to attack an interesting problem concerning engineering managers within our company. These people, although they began their careers as technical specialists, have gravitated by virtue of special talent to the work of managing engineering operations or laboratories. Many of these men find it difficult to understand what the younger men around them are talking about - more particularly, chemists, mathematicians, physicists, or even biological scientists. They may even have trouble with young engineers in their own field.

When he was in the university, the engineer may have had very good "how-to-do-it" courses, but he finds many of his new students well-qualified in quantum mechanics, relativity theory, advanced thermo-dynamics and matrix algebra. He may find that he can scarcely communicate with these employees. His problem is very different from that of the engineering specialist who can return to the university and become up-graded in his own particular speciality. None of these programmes is of much use to the engineering manager. He lacks the scientific background to take a particular course, and he also lacks the time to start at the beginning to obtain the necessary framework.

What we considered he needed was something in between - something which does not exist within the framework of conventional education -- so a programme had to be set up under the joint sponsorship of industry and educators. The result was a 6-week cram course in the fundamentals of science and technology. Thirty engineering managers left their jobs and delegated all responsibility for a 6-week period. The result was an intensive course taught by university-faculty and company representatives. Copies of the subjects and curriculum are available for reference. The genesis of such programmes was due to universities having an awareness

of the need or to industry itself, or to the joint efforts of the two institutions in evolving an effective combined venture.

The training of engineers for general management requires a completely different format, such as that of our advanced management courses.

These particular courses in General Electric have been provided through an eleven to thirteen-week syllabus at the Advanced Management Institute in Crotonville, New York, where the manager is in residence throughout the course. He must completely delegate his Company work for this period and become a full-time student. Emphasis is placed on the multi-functional management of the business enterprise. The class is made up largely of functional managers with an average of about 15 to 20 years of industrial experience (average age about 42). The curriculum is broad, emphasizing basic management principles illustrated by the case study method. To date, about 1,500 General Electric managers have taken this course of study.

For American business, education has come to take on a wider meaning that extends beyond the university's walls. More and more we see education as a continuing part of the job, especially at the higher managerial levels. I do not mean this only in the sense that every challenging job is itself an educational experience, though this, too, is true and relevant. But I also mean that more or less formalized educational programmes become a continuing responsibility for the manager who wishes to keep himself growing with the job. The President of Brookings Institution recently warned a conference on adult education that the pursuit of knowledge is no longer the sole province of the scholar, but is now an equal obligation of the practitioner, whether doctor, engineer, or businessman. Dr. Calkins stated:

> "Experience on the job which once was thought to be the one method of preparing men for broader responsibilities is clearly no longer enough. An understanding of fields beyond one's speciality is increasingly necessary".

In recognition of this relatity, many companies have grown into being major educational institutions in an industrial setting. At General Electric, our rough estimate is that one in every eight company employees is taking some kind of training or education course, equipping himself to qualify for advancement. More than one-third of our technical college graduates (B.S. degree or higher) are taking advantage of at least one of these education courses.

Companies have usually either assumed the complete expense of re-training or continuing the education of the engineer or paid a large part of it. Many companies have paid full salaries for periods of absence for study courses. Usually there has been no difficulty for expenditures of industrial funds for the particularly talented and creative individual, but to provide such training for larger segments of the technical population with more modest capabilities has been more difficult. The time taken from active work and increased company expenses have been real deterrents to the expansion of such programmes.

The re-training of technical employees has been notably unsuccessful when the gap between the background of knowledge and the nex subject-matter has been large. Technician re-training in particular must be very carefully matched to ability.

Individual limitations

We hear a great deal today implying that the employer or the college should be the prime mover in maintaining engineering fitness. It is more in keeping with our concepts of initiative to stress what the individual can do for himself. The engineer could well generate his own programme of self development by being alert at every stage of his career to changes in technology which could have a serious bearing on his career and consider what his own actions should be. These could range from filling in with the new knowledge so that he is prepared to meet the competition of more recent and better-trained graduates, through trying to blend the newer knowledge into his current work, to deliberately taking action leading to a new career in what he concludes is the expanding technical field. In short, he should avoid letting conditions deteriorate to the point where obsolescence has made the return doubly difficult.

His next concern is to determine what he can do to maintain this competence. The most obvious way is to use the vast resources available through the engineering and scientific journals with their records of meetings of technical societies. The meetings, congresses, and technical conferences of these societies provide opportunity for personal contacts and discussions between those with specialized interests. The outpouring of technical books represents another fertile source of help, particularly if the reader has the requisite mathematical background needed to use them. The stimulation we get from professional associates within our individual companies is a powerful factor in keeping up to date. Competition is another factor, whether it is individual or industry-wide.

Much can be accomplished by the individual after he takes stock of all the above opportunities. His most important consideration may well be selecting which material is meaningful for him, and then which of many courses of action he should follow out of all the complexities being offered. He will undoubtedly turn to his own industry and to the colleges to help him expand his professional competence.

Personal motivation

A high motivation to continue and sustain an educational programme is the of utmost importance. As the engineer leaves school, his family and social responsibilities increase; demands upon his time become more intense. While many solutions have been proposed to cover all parts of the problem, one basic fact stands out as dominant - the need to inculcate the individual science or engineering graduate with the concept of continuing his own technical education throughout his professional career to maintain the needed degree of expertness.

Recognition, achievement, responsibility and the work itself are motivators for the scientist and engineer. The establishment of a close relationship between completed studies and increased work responsibility different work assignment and particular forms of recognition should increase personal motivation. Increasing the expectancy of reaching the objectives of the study programme can also be of significant value in enhancing the individual's motivation. Participating in advanced degree programmes rather than taking individual unrelated courses, particularly during the early stages of one's career development has generally been more helpful to motivation.

Without individual motivation, the role of the other segments - the company, the government, the university and the technical society - can be of relatively little value.

II. General Electric USA - A Case Study

General

The General Electric Company is a large diversified company, manufacturing electrical and allied products. Although its operations are primarily in the United States, some 20 per cent of its present business is abroad. Its total overall business is about six billion dollars, making it equal to about 1 per cent of the gross national product of the USA. Its business is characterized by (a) its diversity, and (b) its highly technical nature. As an illustration of (a), General Electric manufactures equipment in 16 of the 21 designated areas of industrial activity. As an illustration of (b), its technical competency is shown in the fact that it employs 27,596 persons with a technical college degree at the bachelor level or higher, and 11,503 college graduates at the same level in non-technical areas. One in seven of our employees is a college graduate, and one in ten of our employees is a technical college graduate. The Company is also characterized as a rapidly growing one, having doubled its business each eight to ten years since its formation in 1892. To maintain its technical position, it is necessary to employ about 2,500 engineers and scientists each year, and about 800 non technical college graduates.

General Electric feels that a programme of continuing education to broaden and up date the engineers' technical knowledge and skills is a necessity. Its engineers and scientists are provided with many opportunities to do this through a variety of educational courses and on-the-job training programmes. To provide this particular case study, detailed information is given on the education and training of engineers and scientists for Research and Development as follows. The programme of education and training for technical employees falls into three categories:

- Specific Courses;
- Educational Assistance Programmes;
- On-the-Job Training Programmes.

Specific Courses

1. Advanced Course in Engineering

(a) Doctoral Programme

A four-year programme which teaches advanced theoretical concepts and analytical techniques as the graduate level, and provides experience in applying them to the solution of practical engineering problems. It combines Company-taught courses with resident college graduate study and job-oriented thesis, and culminates in the award of the doctoral degree by the participating colleges (Polytechnic Institute of Brooklyn and Rensselaer Polytechnic Institute, Troy, NY.). Participants are on full salary, with all costs paid by the Company.

A-Class (First Year) - One four-hour class per week on Company time for 32 weeks plus approximately 20 hours per week homework. Emphasizes application of engineering knowledge and analytical techniques, approach to problem solving, and learning to think from fundamentals. Starts mid-September. A-Class locations will be: Daytona Beach, Fla.; Erie, Pa.; Evendale, Ohio; Huntsville, Ala.; Philadelphia, Pa.; San Jose, Calif.; Schenectady, NY.; Utica, NY.

B-and C-Classes (Second and Third Year) - Two consecutive class days per month at Schenectady, with homework of a project nature emphasizing solution of actual engineering problems, Options in Electrical, Mechanical, and Systems Engineering. Participants commute from their plant location.

College Residence - Three summer periods of seven and a half weeks residence at Polytechnic Institute of Brooklyn Graduate Center, Farmingdale, L.I., involves eight credit hours each session in courses from one of the three fields of speciality (Electrical, Mechanical, Systems).

Thesis - Based on a project which is part of the man's normal work in the Company and at the same time meets the standards of the participating college for significant original work by the individual. In this portion of the programme each student has a University faculty member as his thesis adviser.

Participants - Qualified engineers and scientists interested in graduate-level education in advance engineering and analytical techniques. A-Class selections are based on interview, solution to an entrance problem, and college record. B-Class and college session participants are normally selected from successful A-Class graduates on the basis of interest and class and job performance. Men who have already taken engineering courses at the graduate level or who hold an advanced degree may enter the programme with advanced standing. In some cases, holders of an MS degree may skip the A-Class and first college session, entering the programme at the beginning of the B-Class. In other cases, some of the college session courses may be omitted or others substituted.

(b) Master's Degree Options

Men not completing the doctoral portion of the programme can utilize portions of it to obtain a Master's degree. For example, the programme can left at the end of the C-Class with a Masters degree awarded by the participating college, as well as an Advanced Course key and certificate awarded by the Company. In another case, an experimental arrangement with Rensselaer Polytechnic Institute provides for granting academic credit toward a Master's degree for the A-Class and portions of the B- and C-Classes, the remaining credits being obtained from Rensselaer Polytechnic Institute courses. This programme consists of the following elements:

	Credit
(i) The A-Class	6 semester-hours
(ii) Six three-hour courses at Rensselaer Polytechnic Institute	18 semester-hours
(iii) Six additional semester hours by one of the following alternatives:	6 semester-hours
- The complete B-Class	
- Engineering application portions of B- and C-Classes	
- A thesis	
- Two three-hour courses at Rensselaer Polytechnic Institute	
	30 semester-hours

(c) Non-Degree Options Programme

A modified version of the Advanced Course involving only the A-, B-, and C-Classes is available in two locations - San Jose, California, and Utica-Syracuse, NY. This programme dispenses with the college sessions. The A-Class is common to the Doctoral Programme, but the B- and C-Classes are modified to compensate for lack of the college session material. They meet once a week on the same schedule as the A-Class.

2. Creative Engineering Course

(a) Schenectady

A 32-week programme of lectures, tours, reading and problem solving in a wide range of subjects, designed to provide an horizon-broadening experience both in technology and in its social and economic implications, as well as insight into opportunities for innovation and an understanding of the creative approach. One seven-hour class every other week on Company time, plus five to ten hours per week home preparation.

Content

Creativity Studies	3 sessions
Review of Modern Technologies	5 sessions
Tours of Company Laboratories	4 sessions
Economic and Business Implications	1-1/2 sessions
Projects and Presentations	2-1/2 sessions

Participants - Development, Design and Manufacturing Engineers with five or more years' experience, from departments within reasonable access of Schenectady, on the basis of managerial selection.

(b) Chicago

The second year of a two-year course in creative engineering for young engineers, designed to provide appreciation of the creative process and experience in the practical solution of real design problems. This second year concentrates on the mathematics and other analytical tools needed properly to evaluate proposed (conceptual) solutions. One four-hour class per week for 32 weeks in Company time.

Outline

Engineering Fundamentals, Mathematical Tools, and Analytical Techniques	12 weeks
Engineering Relationships with Other Functions	2 weeks
Creative Approach - Problems and Seminar	10 weeks
Projects and Presentations	8 weeks

Participants - Technical personnel in all functions, from departments in or near Chicago, who have previously completed the first year of the course.

3. Modern Engineering Course

A highly concentrated six-week (full time) lecture and reading programme designed to bring managers and experienced technical personnel up to date on pertinent and recent developments in fields of mathematics, physics, materials, and technology which have a direct and dominating influence on modern engineering. The intention is to create an understanding and sound appreciation of important new scientific and engineering concepts and their applicability rather than a detailed working knowledge. Given twice a year, in the spring and autumn.

Outline

Mathematics

- Set Theory
- Matrix Algebra
- Calculus
- Complex Variables
- Differential Equations
- Vector Analysis
- Numerical Analysis
- Operational Transforms
- Statistics and Probability
- Decision Theory
- Statistical Mechanics

Physics

- Atomic structure Radioactivity
- Nucleonics, Particles and Cosmic Rays
- Relativity
- Electricity and Magnetism
  - Statics Dynamics, Waves, Currents, Plasmas
- Quantum Mechanics

Mechanics

- Thermodynamics
- Energy Conversion
- Stress Concepts
- Transport Phenomena
- Buckling Analysis
- Vibration Analysis
- Shock Analysis

Materials

- Metals
- Ceramics
- Polymers
- Properties
  - Electrical, Mechanical, Therm
  - Optical, Magnetic

Systems

- Circuit Analysis and Analogs
- Information and Noise
- Modulation Systems
- Linear Systems
- Feedback Theory
- Root Locus Techniques
- Frequency Response
- Computers

General

- Value of Money
- Value of Experiment
- Encoding of Knowledge
- Tree of Decision
- Market Approaches
- Modern Economics

Participants - Engineering managers and technical leaders by management appointment. Usually about age 35-40 with 5-10 years technical management experience (and an average of 15-20 years total industrial experience).

4. Specialized Technical Courses

Courses in a great variety of specific technical subjects of interest to their employees are developed and presented by many individuals departments. In multidepartment locations it is usually possible for people from several departments to join in the same class. Depending on the nature of the subject, such courses may be from a few weeks to a year or more in duration, either all or in part on Company time, or entirely after hours. Normally, they are at no cost to participants, and participation is in most cases voluntary.

A recent survey showed educational activity of this nature in the Company at a rate of over 5,600 man-courses per year. The most popular general subject areas include:

- Computers
- Mathematics
- Transistors and Semiconductors
- Electrical Engineering and Electronics
- Materials and Metallurgy
- Mechanical Engineering and Design
- Servomechanisms and Control
- Nuclear Engineering
- Mechanics
- Systems Engineering
- Physics
- Reliability and Quality Control

Participants - Generally available to any technical employee. Course availability generally dependent on the demand, and on availability of a competent instructor.

5. Non-Technical Courses

Courses in non-technical subjects are frequently available in most departments on the same basis as described for Specialized Technical Courses. The most popular subject areas include:

- Planning and Scheduling (PERT)
- Orientation Courses
- Technical Writing
- Effective Presentation
- Business Management
- Creativity

Educational Assistance Programmes

1. Tuition Refund

A programme to encourage employees to further their education and training through additional academic work by refunding all or part of the cost of tuition and other expenses. To be eligible for tuition refund, a course must be given by a recognized educational institution and be directly related to the employee's present or anticipated field of work (or be a required course in a programme leading to a degree appropriate to his field of work). Preferably, courses should be scheduled after working hours, but where this is not practical, reasonable time off from work may be granted without loss of pay. Special arrangements can usually be negotiated if excessive absence from work will be necessary.

Refunds are granted only after successful completion of the course(s) involved. The amount of the refund and the expense items that may be included are at the discretion of the department manager, and may be scaled according to academic achievement. Employees should obtain approval to apply for reimbursement before enrolling in the course, and should determine at that time the basis on which it will be made.

Participants - Any Company employee is eligible, provided prior management approval is obtained.

2. Honours Graduate Study

A programme for highly qualified technical employees consisting of part-time study at a recognized academic institution for the purpose of obtaining an advanced engineering or science degree (MS or doctorate). See Honours Graduate Study Programmes are generally established on an individual basis to meet the needs of the person(s) involved. Hence there may be wide variations in the programme content, the amount of time required away from work, and the resulting financial arrangements that are established. However, the following basic standards apply.

(a) The Programme should start at graduate level and lead to an advanced degree of recognized standing.

(b) It should be related to the field in which the employee is or will be working.

(c) The graduate school should be of high quality, capable of challenging students of the calibre selected.

(d) Students must meet the criteria for acceptance by the graduate school as a candidate for the degree, and take the responsibility for gaining admission to the school on that basis.

(e) The Programme should be carried out on a continuous basis and at a reasonably brisk pace, normally at not less than six credit hours per semester.

(f) Students should meet continuing high standards of academic performance. An average of B or better with no more than one C is appropriate.

Participants - Selected technical personnel qualified to undertake advanced degree work at a high level of academic performance, and for whom an advanced degree or the educational experience involved is judged to be desirable in his work.

Graduates of the A-Class might look to this programme as an alternative avenue to a Masters degree, and at some schools obtain academic credit for the A-Class toward the degree.

3. Educational Leaves of Absence

Qualified employees may obtain a leave of absence for a reasonable period to pursue a job related to educational programme on a full-time basis. Leaves of absence are without pay or service credit, but serve to protect credits for prior service. Employees on leave of absence may also select to maintain their Company group insurance during the absence. In addition, depending on individual cases, the Company may assist financially through refund of tuition costs and/or payment of a living allowance. A living allowance, if granted, might be expected to approximate the amount of typical stipends associated with graduate fellowships.

Participants - Employees with two years or more of service who have demonstrated a high level of value to the Company through their performance. (Employees not meeting these conditions who terminate their service for educational purposes may have prior service restored provided they return promptly after completing the educational programme).

4. Educational Loans

Under this programme Department Managers are authorized to make loans to employees for full-time college study by either the employee or his children. The loans may be for any amount up to $ 1,000 a year per student in any calendar year, with a maximum total outstanding of $4,000 for any one student and $8,000 for any one employee. Interest is charged on the loans (currently at 4-1/2 per cent), and repayment may be made by payroll deduction.

Participants - Employees with at least one year's continuous service, and with management approval (plus certain other categories of former employees or their children).

On-the-Job Training Programmes

1. Product Engineering Programme

A programme of product engineering work assignments for young engineers to acquaint them with this type of work and with the Company. Administered by Engineering Services, the programme provides for three six-month assignments in different product departments during which the trainee works directly for or in close association with leading engineers in their field. Assignments are in industrial, utility, and consumer product areas and are designed to maximize the programme member's contribution to all phases of product development and design. While not formally a part of the programme, the same educational opportunities are available to trainees as to other engineers. Assignments are available in thirty-two different departments. Off-programme placement may be anywhere in the Company, although preference is given to the participating departments.

Participants - Newly hired electrical or mechanical engineers (or equivalent) at the BS or MS level. Trainees normally are hired off the campus directly into the Programme.

2. Division Rotating Programmes

There are several rotating assignment programmes operating to meet the training needs of deparments within a single Division. In general, they are intended for new employees, recently graduated, and consist of

three to four different work assignments of from four to six months, frequently in as many different departments. Some include assignments in both Engineering and Manufacturing. They may or may not include formal educational activities. Off-programme placement is normally within the Division involved.

3. Department Rotating Programmes

Many departments of the Company operate rotating training programmes of their own for their newly hired engineers. These programmes are specialized in the particular product line and most frequently are at a single Company location.

Motivation - Particular effort is made toward the self-motivation of the individual technical man by means of two specific management methods. First, tuition refund programmes have involved the payment of educational expenses only after satisfactory completion of a specific course with a passing grade. The technical man must initially finance this venture and then be reimbursed later. Trials using differing techniques of financing have shown the refund method to have the highest motivating influence.

Second, and perhaps most important, is the role of periodic evaluation of the man's performance. Increased depth of challenge on regular work assignment must keep pace with increasing technical competence. It is also important that compensation be increased proportionately. Frequently, transfers from specific plant locations are necessary to keep pace with the increased competence of the individual. Further motivation is provided by publicity, locally and with professional societies, when advanced degrees are obtained in these programmes.

C. INSTITUTIONAL ASPECTS OF
THE DEVELOPMENT OF NATIONAL POLICIES

THE GROWTH AND CO-ORDINATION OF SCIENTIFIC AND TECHNICAL MANPOWER STUDIES IN THE UNITED-KINGDOM

by G. J. Spence
Joint Secretary - Committee on Manpower
Resources for Science and Technology, United Kingdom

Origins

Studies of supply and demand for highly qualified manpower in science and technology began in December, 1945, as the result of the immediate need to make good the war-time restrictions in university output and to meet the needs of industries which were reconstructed after the 1939/45 war. The subject was first studied in relation to scientists only in the "Barlow Report" on Scientific Manpower of 1946 (Cmd. 6824). In this report an actuarial technique was used successfully to estimate the existing capital of scientists. The Barlow Committee also estimated the increase in the output from universities which would be necessary to meet demand.

In December 1950 the Committee on Scientific Manpower was established under the Chairmanship of Sir Solly Zuckerman with the following terms of reference:

"To study the future needs of scientific and technological manpower for employment both at home and abroad and to report to the Advisory Council on Scientific Policy from time to time".

In 1952 the Committee published its first report on scientific and technological manpower, but this was a qualitative and not a quantitative survey as the statistical basis for a survey of scientists and technologists in employment did not at that time exist.

Early quantitative surveys

The first survey of employment was undertaken in 1956 and since that year has been repeated on a triennial basis. As a result of the 1956 survey, the Committee on Scientific Manpower calculated that the annual output of qualified scientists and engineers in the UK., which was then about 10,000 a year, would need to be doubled by 1970. The Government accepted this recommendation and the response from institutions of higher education was such that an output of 20,000 a year was achieved by 1965. Of this total, approximately half were scientists - a higher proportion than in most other countries.

As early as 1956, the Committee on Scientific Manpower made broad assumptions about the relationship between the output of industries and their employment of qualified manpower, and in a report in 1961 (Cmd. 1490 - The Long-Term Demand for Scientific Manpower) showed the possibilities of estimating needs for qualified manpower by taking account of the probable changes in the ratio between total employment and the employment of scientists and technologists and the growth of the industry. Preliminary results from the 1965 survey of scientific and technological manpower have shown that this forecasting procedure gave good results. Other attempts to relate demand for highly qualified manpower to econometric models constructed for the purpose of measuring economic growth were less successful at the first attempt but this approach is very promising and will be pursued with the help of the Ministry of Technology. In 1962, a high proportion of scientists and technologists in manufacturing industry (37 %) were engaged in research and development and hence were contributing to productivity only at one remove and over a very variable period. Attempts to quantify either the time-lags involved or the relationship between the input into research and development and the output in the form of increased production have not yet been sufficiently studied, but study of the many problems involved is continuing.

The opportunity was taken to incorporate in the special 10 per cent sample questionnaire of the 1961 Census of Population a question about scientific and technological qualifications so as to provide a second source of statistical information on the numbers of scientists and technologists in employment, whether as professional "scientists" or in other occupations. The results of the Census confirmed that the numbers employed in those sectors of employment which it had not been practicable to cover by the triennial surveys were larger than had hitherto been shown in the Reports, partly because of "non-scientific" employment, and the opportunity was taken in the 1962 Manpower Survey to reconcile the results

(Cmd. 2146, Table 2, Page 11). It is provisionally estimated that at the present time there are about 300,000 qualified scientists and technologists in employment or as graduate students or research workers in the UK.

Later organisation

Until October 1964, studies of scientific and technological manpower had been co-ordinated by the office of the Minister for Science, and latterly the Department of Education and Science; the statistical work had been shared between many Departments. In particular, the Ministry of Labour undertook to supply the basic statistics of employment through the triennial surveys of scientist and technologists while the work of analysis was carried out in the Central Statistical Office. The Committee on Scientific Manpower had a Technical Sub-Committee under the Chairmanship of Sir H. Campion to assist it in its task and this ensured satisfactory Departmental co-ordination.

Present organisation for scientific and technological manpower policy

At the end of 1964, following the change of Government, the Ministry of Technology was established to encourage advanced technology in British industry; in addition, the Ministry assumed those of the responsibilities of the former Department for Scientific and Industrial Research which related to the furtherance of technology in industry. New arrangements were thereupon made to co-ordinate the study of scientific and technological manpower under the joint auspices of the Ministry of Technology and the Department of Education and Science. A new Committee, the Committee on Manpower Resources for Science and Technology, under the Chairmanship of Sir Willis Jackson, was established.

Terms of reference of the Committee on Manpower Resources for Science and Technology

The terms of reference of the new Committee, supported by the combined resources of both Departments, were widened to take account of the concept of the stock of highly qualified manpower as a natural resource. As the Committee stated in the second paragraph of its report: "Our function is to advise you on manpower resources for science and technology. We have interpreted this responsibility to include the effective use of the whole stock of scientific and technological manpower as well as the output of newly qualified individuals in relation to employment opportunities. This is because we believe that the deployment within the economy of existing scientists and technologists, and their utilisation within any organisation, demand as careful and urgent consideration as the supply from the educational system".

The Committee has recently published (Cmnd. 2800) its first report on the Scope and Problems of Scientific and Technological Manpower policy. This report was presented to Parliament by the Secretary of State for Education and Science and the Minister of Technology.

In the course of its Report, the Committee developed a plan of work which emphasised that its thinking had progressed considerably from the enumerations of earlier surveys. It emphasised the importance of factors bearing upon the choice of scientific and technological subjects by pupils in schools (reflecting the specialisation which takes place in 6th forms in the UK); the problem of the match between the educational system and the requirements of employers; and the importance of measures for the effective utilisation of the existing stock of qualified manpower during the career.

The Committee set out a list of seven subjects for future study:

(a) Implications of long term economic planning for scientific and technological manpower policy.

(b) Identification of motivations, character, and abilities relevant to science and technology, and the factors which govern the choice by individuals of a scientific or technological career.

(c) Identification of the main categories of scientists and technologists needed by industry and the relationship of industry's requirements to educational courses.

(d) The extent to which present resources of ability are fully mobilised in the production of scientific and technological manpower.

(e) Problems of effective deployment and utilisation of scientists and technologists at all stages of their careers, including problems associated with obsolescence of knowledge and skills; isolation in small organisations; and inadequate mobility from field to field within scientific and technological employment.

(f) The relationship between scientists and technologists and their technical supporting staff.

(g) The migration of scientists and technologists internationally and within the economy.

In its concluding paragraphs the Committee laid emphasis on the continued need for more facilities in science and technology at universities, for the teaching of science and mathematics in schools to be imaginatively related to their subsequent application; and for attention to the ways in which the links between employment and education can be fostered, whether by "sandwich courses", better planning of courses between employers and education establishments, or by extension of courses for candidates with experience in employment. The Committee drew attention to the opportunities now provided in the UK by the establishment of Industrial Training Boards.

This Report is a preliminary one and is intended to set the scene for an interpretation of the 1965 triennial manpower survey results. A report on the latter is in draft and is expected to be published early in the autumn. A Group under Professor Swann is examining in particular the implications of the data from the survey for scientific policy generally and in particular the rate of growth of resources for the assistance of scientific and technological research by the Research Councils.

Arrangements have been made to co-ordinate Departmental work on these problems under the aegis of the Committee on which there are eight top-level advisers from industry; six university professors; a trade unionist; and representatives from the main Government Departments (1) with an interest in scientific manpower. A separate committee of officials has also been appointed to co-ordinate statistical and other Departmental work and to assist the main committee. The present membership of the Committee is given in Appendix "B".

The Committee has initiated work in a number of fields; sub-Committees have been set up to deal with the problem of the conversion of the graduate engineer to a product technologist of direct value to industry, the effect of availability of manpower on the desirable rate of growth of expenditure on science, as mentioned above, and the Committee has contributed to studies on the flow of candidates in science and technology into universities commissioned by the Council for Scientific Policy. In all these operations, the Committee has drawn upon Departmental support as required. In particular, there are close links with the Ministry of Labour on the implications of the new industrial training arrangements provided by the Industrial Training Act, which sets up a contributary fund from which contributions to the training of highly qualified manpower may be made by Industrial Training Boards set up in each sector of industry.

Other research

The Committee on Manpower Resources for Science and Technology is kept in touch with research projects and investigations bearing upon scientific manpower policy, and a brief bibliography was appended to its Report. Much of this work is undertaken at universities as part of independent sociological research, but Government Departments have resources to commission additional studies directly.

(1) Central Statistical Office, Department of Economic Affairs, Ministry of Overseas Development, Science Research Council, Ministry of Technology, Ministry of Aviation, Department of Education and Science, Ministry of Labour, Scottish Education Department, University Grants Committee.

<u>Appendix A</u>

UNITED KINGDOM PUBLICATIONS ON SCIENTIFIC AND TECHNOLOGICAL MANPOWER POLICY

"Scientific Manpower" (1946 Cmnd. 6824). Report of a Committee appointed by the Lord President of the Council (The "Barlow Report")

"First Report of the Committee on Scientific Manpower" (published as the fifth Annual Report of the Advisory Council on Scientific Policy, 1952, Cmd. 8561).

"Scientific and Engineering Manpower in Great Britain" (HMSO 1956: reprinted 1957. (The first triennial survey).) Office of the Lord President of the Council and Ministry of Labour and National Service.

"Scientific and Engineering Manpower in Great Britain 1959" (Cmnd. 902) Advisory Council on Scientific Policy and Committee on Scientific Manpower.

"The Long-Term Demand for Scientific Manpower" (1961, Cmnd. 1490 Advisory Council on Scientific Policy and Committee on Scientific Manpower.

"Scientific and Technological Manpower in Great Britain 1962" (Cmnd. 2146). Advisory Council on Scientific Policy and Committee on Scientific Manpower.

"A Review of the Scope and Problems of Scientific and Technological Manpower Policy" (1965, Cmnd. 2800). Committee on Manpower Resources for Science and Technology.

The following publications by the General Register Office dealing with the 1961 Census of Population are also relevant:

"Great Britain: Scientific and Technological qualifications" (Statistical Tables derived from the 10 % Sample Survey).

"England and Wales: Occupation and Industry - National Summary Tables" (1965).

Appendix B

COMMITTEE ON MANPOWER RESOURCES FOR SCIENCE AND TECHNOLOGY

Membership

Professor Sir Willis Jackson (Chairman), Professor of Electrical Engineering, Imperial College of Science and Technology.

Sir Léon Bagrit, Chairman and Managing Director, Elliot Automation Limited.

Professor J.G. Ball, Professor of Physical Metallurgy, Imperial College of Science and Technology.

Mr. G.S. Bosworth, Director of Group Personnel Services, English Electric Limited.

Mr. S.L. Bragg, Chief Scientist, Aero Engine Division, Rolls-Royce Limited.

Dr. E.F. Brookman, Managing Director, Paints Division, Imperial Chemical Industries Limited.

Lord Brown of Machrinhanish (1), Chairman, Glacier Metal Company Limited.

Professor F.S. Dainton (2), Vice-Chancellor, University of Nottingham.

Dr. S.G. Hooker, Technical Director (Aero), Bristol Siddeley Engines Limited.

Professor S.P. Hutton (3), Professor of Mechanical Engineering, University College of South Wales and Monmouthshire.

Dr. F.E. Jones, Managing Director, Mullard Limited.

Professor C.A. Moser, Professor of Social Statistics, School of Economics and Political Science, University of London.

Mr. C.H. Offord (4), Managing Director, Honeywell Controls Limited.

Professor L. Rosenhead, Professor of Applied Mathematics, University of Liverpool.

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(1) Resigned on appointment as Minister of State, Board of Trade, October 1965.

(2) Co-opted from the Council for Scientific Policy, April 1965.

(3) Appointed April 1965.

(4) Appointed May, 1965.

Professor J.R.N. Stone, Leak Professor of Finance and Accounting, University of Cambridge.

Professor M.M. Swann (1), Professor of Zoology and Dean of Faculty of Science, University of Edinburgh.

Sir Peter Venables, Vice-Chancellor Designate, Proposed University of Aston.

Mr. P. Fisher (2), Secretary of the Production Department of the Trades Union Congress.

The following Government Departments are also represented on the Committee:

Central Statistical Office
Ministry of Aviation
Department of Economic Affairs
Department of Education and Science
Ministry of Labour
Ministry of Overseas Development
Science Research Council
Scottish Education Department
Ministry of Technology
University Grants Committee

Joint Secretaries

Mr. S.W. Spain, Ministry of Technology

Mr. G.J. Spence, Department of Education and Science

Since its creation on 4th February, 1965, the Committee has held 14 meetings. It normally meets at least once a month.

(1) Appointed February, 1965.

(2) Appointed March, 1966.

RECENT INSTITUTIONAL CHANGES
FOR IMPROVED MANPOWER UTILISATION
IN CANADA

by the
Department of Citizenship and Immigration
Ottawa (Canada)

I. Introduction

The purpose of this paper is to provide some information about recent institutional changes in Canada at the national level concerning policies for the development of human resources. The utilisation of human resources is a broad problem encompassing many issues and involving a wide range of institutions within the community, and therefore requires a comprehensive approach. A new approach has recently been made in Canada by the creation of a new Federal Department of Manpower and Immigration which has been given responsibilities for developing and administering manpower policies and programmes at the national level.

The objectives of manpower policies

The basic aim of manpower policies is to help to achieve the social and economic objective of improving human welfare by moving towards a better distribution of manpower in relation to opportunities for employment. This in turn implies a cluster of related objectives, and the effective development and application of national policies to improve the utilisation of manpower resources requires integration and co-ordination at the

national level. General economic policies and manpower policies are complementary and need to be developed in relation to each other. The aggregative and non-discriminatory approach of monetary policy has to be supplemented by more selective techniques such as fiscal measures and manpower policies in order to deal with particular problems. In this way manpower policies are potentially capable of assisting in the effective attainment of general social and economic objectives.

The problems of manpower development relate to both the education and training and to the use of that trained manpower in employment. Since the strategy of human resource development and utilisation involves interrelated and overlapping problems, a coordinated and integrated approach is required. A labour surplus, for example, may be in part the result of a poorly planned system of formal education and training, but it may also be the result of ineffective public labour market policies. In addition to the determination of present and future requirements for manpower, changes in demand, output and technology, and in occupational requirements will imply the need for an adaptation of individuals in the labour force to employment opportunities, while the development of technology, the management of the labour force and the growth of the economy require the best development and utilisation of the human resources of the community. A more effective matching of supply and demand, i.e. of people and opportunities, requires an improvement of the labour market in order that these dynamic mutual adjustments of the labour force to employment and of the use of the labour force to its capacities may be made more readily.

The concern with manpower resources, with their development, with identifying current and future manpower requirements, and with their most effective utilisation throughout the community and within particular agencies and establishments is widely shared in Canada. In the Canadian institutional setting, the development of effective national manpower policies necessarily entails collaboration with other agencies such as the provincial governments, employers and employee organisations. The Minister of Citizenship and Immigration has said.

> "... I am convinced that a national manpower policy is a national problem and can only be dealt with as such. However, this does not mean that it is a problem to be solved solely by the Federal Government" (1).

In Canada, although education is constitutionally a responsibility of the provinces, there is a community of interest between the manpower authorities and those responsible for the educational system. This had led to collaboration between the federal and provincial governments in which the federal government has provided grants towards the cost of providing facilities for technical and vocational training at the secondary and post-secondary levels of education. In adult education the federal and provincial governments are jointly involved in the provision of training programmes, and the link at this level between educational planning and economic and occupational requirements is particularly close.

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(1) Address by the Hon. Jean Marchand, Minister of Citizenship and Immigration to the Canadian Manufacturers Association, Montreal, June 6, 1966.

The implementation of manpower policies

A good deal of attention has recently been devoted to the contribution that general education and manpower policies can make to economic growth. In its Second Annual Review, December 1965, the Economic Council of Canada stated that the area of greatest need for effective action is that of manpower and labour market policies. To this end, a number of policies were suggested:

(i) Matching of people and jobs. This entails setting up efficient labour market facilities and services to promote better operation of the labour market as a means of more effectively matching people and jobs.

(ii) Oversupply. The expansion of programmes for training and re-training of the labour force was recommended. It involves increasing the extent of occupational mobility by means of education and training, and re-training new and existing members of the labour force.

(iii) Information and research. More information is needed on present and prospective job opportunities by industry, by occupation, and by area as a basis for matching people and jobs, planning manpower policies for the future and preventing labour market imbalances.

(iv) Incentives and assistance to promote geographic mobility. This would involve economic and non-economic assistance to workers as a means of promoting geographic mobility and alleviating bottlenecks in the labour market.

Basic to the above types of labour market policies is the maintenance of a high and stable level of employment and economic growth. Indeed, this an essential prerequisite of all the others. Manpower policies can help to mitigate the bad effects of widespread unemployment but their contribution to economic growth and productivity can be made most effectively in a climate of high and stable aggregate demand.

II. Canada: The economic and institutional setting

The evolution and recent development of manpower policies can best be understood in the light of the political, social and economic background in Canada. The factors that have shaped institutional arrangements relating to manpower utilisation policies as well as other national policies are the large size and relatively sparse population of the country; the federal and bicultural character of the country; rapid population growth and economic changes in recent times.

The combination of large physical size and relatively small population has been reflected in a widely dispersed population tending to cluster around national resources wherever they are located. Many of these concentrations of industry and population are widely separated and as a result Canada's economy is highly regionalised. In addition, historically

Canada has developed from two main cultures, English and French. These factors have been reflected in the evolution of a political structure consisting of ten provincial governments and a national federal government. In the case of education, for example, responsibility rests with the ten provincial governments. In the case of the closely related matter of manpower development, responsibility is shared by the provincial governments and the federal government.

During the past few years, Canada has experienced large changes in its population and in the labour force. Between 1954 and 1964 the population increased by 26 per cent, which was one of the highest increases among the OECD countries, compared with approximately 17 per cent in Japan, over 15 per cent in the United States and just under 8 per cent in the United Kingdom. The changes taking place within the population structure are even more striking than the change in the total population: the age group 20–24, which increased by less than 7 per cent from 1950 to 1960, is expected to increase by over 50 per cent between 1960 and 1970 (1). The Canadian economy is an open one, with a substantial proportion of Canadian industry competing for sales abroad in world markets. The contribution of technological development and innovation to competitive efficiency is therefore a very important consideration. Industry has been in a state of rapid technological change with consequent implications for the adjustment of manpower. For example, there has been a shift of labour away from "blue-collar" or production occupations to "white-collar" occupations. The proportion of production workers in manufacturing, for example, dropped from 83 per cent of total employment in 1948 to 76 per cent in 1960. In addition, there have been substantial changes in the occupational structure itself. Between 1951 and 1961, professional occupations increased by almost 65 per cent compared with an increase of under 13 per cent for manual occupations (2).

The labour supply of the 1960's will consist to a much greater extent than in the past of young people from the native population who have relatively high levels of education but little work experience. The long-term relative shift of labour away from the goods-producing industries into the service industries has meant that many of the job openings in the service industries require a high level of education and those displaced from the goods-producing industries often have mediocre education and little experience that would be of value in the service industries. At the same time, technological change has been a factor in shifting labour requirements from blue-collar occupations to a variety of white-collar occupations. It has also raised the education the education and training requirements of the economy and increased the proportion which technical and professional occupations make up of the total labour force.

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(1) Economic Council of Canada: "Economic Goals for Canada", December 1964, p. 36, Queen's Printer, Ottawa.

(2) Department of Labour, Economics and Research Branch: "Occupational Trends in Canada, 1931 to 1961, 1963", pp. 40 and 41, Queen's Printer, Ottawa.

Historically, Canada has relied quite heavily on immigration to obtain trained manpower whenever it was needed. In the past decade, however, Canada has had for the first time in its history to assume much more of the burden of training its own manpower by providing the training of its own youth in the post-war population bulge now going through the schools and universities, and by re-training adults to enable them to keep up with rapid technological development. The population bulge which had its origin in the high birth rates after World War II is now entering the universities and the labour force in substantial numbers. The increase in university enrolment is proportionately greater than the increase in the younger age groups in the population because participation in university education is increasing. Between 1954 and 1963, the population ages 18-24 rose by over 18 per cent while total university enrolment rose by over 120 per cent.

Certain characteristics of the Canadian labour market, some of which are unique, have directly influenced the shape of manpower utilisation policies. The Canadian labour market has been characterised by cyclical and seasonal variations in the level of employment. During the cycle of economic activity there is a considerable shifting of employment between industries (1).

There have also been considerable differences in the rate of employment and labour force growth in various regions of Canada, which in turn have necessitated a relatively high geographic mobility requirement of the labour force. There is a need to shift workers from one area to another as a result of differences between the growth of employment and of the native population of labour force age. It has been estimated for estimated for example that there will be an increase of nearly a third in the 20-24 year age group in the labour force in the second half of this decade. These influences have meant that Canada has two very large training tasks to do on a scale that has never before been attempted.

III. Recent changes in the structure of manpower planning in planning in Canada

Since January 1 of this year, all federal responsibilities relating to manpower have been concentrated in the Department of Manpower and Immigration. One of the guiding principles in the organisation of the new department is to provide the capability for comprehensive counselling service to all members of the labour force which will relate the present and potential capacities of the individual to employment opportunities.

Objectives of the new Manpower and Immigration Department

A new department will be organized into three divisions, the Canada Immigration Division, the Canada Manpower Division, and the

(1) "Manpower and Employment". Trends, Policies and Programs, a report prepared by Canadian authorities for the Organisation for Economic Co-operation and Development, March 1965.

Programme Development Division. The first two will be operating divisions. The Canada Immigration Division will be responsible for the recruitment and admission of immigrants into Canada. The Programme Development Division will be responsible for the development of manpower policies and programmes, and for co-ordination of the economic programmes of the department with other departments of government and for the provision of labour market information to guide the operations of the Canada Manpower Division. It will be composed of branches for Research, Planning and Evaluation, Labour Market Analysis, Pilot Projects and Legislation and Legal Services. The implementation of the active manpower programmes will be the responsibility of the Canada Manpower Division, which is to be a strong integrated national manpower service with offices across Canada organized to give a full range of advice, counsel and service to worker and employer.

Plans and programmes

The plans and programmes of the new department may be divided into three groups, those which will have a major impact upon the organisation and functioning of the department, those which aim at improving utilization of manpower currently and in the short run, and those which will have a greater impact on utilization in the intermediate and long-term future.

There are two major organizational changes which aim at improving the overall effectiveness of the manpower service: first, the adaptation and expansion of the Canada Manpower Division to meet rapid technological change; secondly, the co-ordination of immigration policy and practices with the demands of the labour market.

The crucial production point in the manpower process where counselling is done is the employment office. These employment offices came into existence in the past primarily in order to help the unemployed. However, in a dynamic changing economy it is felt that the role they need to play is now entirely different, and the new Canada Manpower Division will provide a conselling service to all members of the community, whether in employment, unemployed or outside the labour force. The reaction speed of the response to technological and economic changes can be improved by making people aware of new opportunities and of the training and other programmes that are available to help them take better advantage of those opportunities.

The Canada Manpower Division will function on three levels: national, regional and local, with a large degree of decentralized responsibility. It is anticipated that the local or area office will be the focal point of all manpower programmes, and it is hoped that the area office will become a professional consultative service to employees and employers.

All employment area offices will offer a broad range of services including information on job opportunities, counselling services and, where necessary, aids and incentives for training and geographic mobility. This means that the service will also be a source of supply of workers from within Canada and from abroad. The Canada Manpower Division will offer a full range of services to assist the integration of immigrants into the industrial, social and cultural life of the country.

There are a number of plans and programmes which will have the greatest impact on manpower utilization in the current or short-run period. The Canada Manpower Division will serve as the focal point of efforts to improve utilization in the short run. In addition to a consulting service and the provision of information on job opportunities, financial assistance will be provided under the Manpower Mobility Programme. Under this programme financial assistance will be provided to those workers who are unemployed and who find it necessary to move to other areas where there are employment opportunities. This programme, which is national in its scope, provides loans and grants to workers and their families to cover the cost of moving. An amendment to the Manpower Mobility Regulations permits financial grants to unemployed workers to assist them in moving from areas where they have no opportunity of securing suitable employment to areas where suitable employment is available.

The Manpower Consultative Service is available for consultation with management and the unions in all matters related to the fields of manpower adjustment.

The role of the Program Development Division is particularly important in view of the administrative role to be played by the two large operating divisions and because of the need for the provision of support services to the operational divisions. This support will include the provision of information on current demand and supply conditions in the national labour market, information on longer range manpower requirements and supplies, including the impact of changes in occupations, technological and productivity changes and trends in immigration and emigration. The Planning and Evaluation Branch will provide a means for the development and evaluation of the policies and programmes of the department. There will be an emphasis on setting up special pilot projects to develop better techniques for the training and re-training of manpower. Priority is being given to the gathering of comprehensive information relating to manpower needs which will be used to produce broad analyses of manpower trends on a national scale. Data on scientific and professional manpower will be considerably expanded and studies will be made of a larger number of high-level occupation. It is hoped that these additional studies will provide a better understanding of the structure and operation of the market for high-level manpower in Canada.

The most difficult training task involves adults whose basic education level makes it hard for them to take advantage of training courses at the technical level. It is felt that a greater effort is needed in this area, since it will take many years to raise the average level of skills of the total labour force if training is largely limited to younger persons. A new policy was announced early this year which aimed at separating the connection between unemployment and training for those who are unemployed and being retrained. An unemployed man who goes on a training course will be entitled to an allowance to support himself and his family while in[illegible]g. He will no longer be regarded as unemployed. He will not d[illegible] unemployment insurance, and his rights to unemployment benefits will be preserved.

A number of plans and programmes will have their greatest effect upon manpower utilization in the intermediate and longer-run future. Working in co-operation with the provincial governments, the federal government through a system of financial assistance to the provinces has

stimulated an extensive programme for youth, including technical and vocational courses all across the country. The Technical and Vocational Training Assistance Act of December 1960 decisively changed the pattern of technical and vocational training in Canada. The new legislation provides for greater assistance to the provinces which enables them to meet more effectively the urgent need to train both the youth and the adult population.

The federal government co-operates with the provincial government departments of education and labour, employers' organisations, labour organisations, and with federal government departments and agencies in the promotion, organisation and development of various types of public training programmes which are thought necessary to prepare people for employment or to retrain or to upgrade workers in their present occupations.

The Technical and Vocational Training Assistance Act provides for sharing of the capital costs of buildings and equipment for various levels of training up to 75 per cent of capital costs. This assistance was to end in March 1967 but the capital provisions were extended until March 1967 but the capital provisions were extended until March of 1970. Under this programme, the number of student places available for technical and vocational training rose from 108 thousand to 363 thousand in 1966. In addition, the federal government contributed to part of the operational costs of several of these programmes.

There are three types of programmes. These include longer-term pre-employment training programmes for youth, programmes for vocational training, re-training and upgrading of adults and smaller programmes for aid to students and to stimulate research in matters concerning training.

A new experimental programme has been established jointly with the provinces. Pilot training projects have been designed to develop new training methods for adults whose basic education is low. These programmes will be set up jointly between the federal government and the provinces, and will be set up in areas of special difficulty where there is substantial unemployment or underemployment and a pressing need to raise the level of skills.

Basic to the long-term plans and programmes for manpower utilization will be research efforts to establish a better understanding of the working of the labour market. Estimates will be made of manpower needs in relation to the supplies of workers for the longer-term future, and to the type and level of education and training which will be required in the economy of the future.

Thus the role of the department has been conceived as that of a catalyst as well as a co-ordinator and a consultant to management and labour. While training facilites have been established with the co-operation of the provinces as well as arrangements for pilot training projects, it is felt that the chief present solution is to provide a professional consultative service to all parts of the world of work.

IV. Towards better manpower utilization

Utilization must be considered as more than a static process of resource allocation at a particular point in time. In the absence of change, the task of manpower utilization would be greatly reduced to a matching of supply and demand at a given point in time. But in a dynamic economy the scope of the problem is much broader since the response to rapid changes in the supply and demand of manpower may require redeployment, broad training as a prerequisite to adaptability plus attention to the mobility of manpower over time. The very rapid and continuing changes in manpower needs in Canada in recent years have directed attention to institutional arrangements which will help to develop maximum adaptability and flexibility of manpower resources in response to these changes.

The nature of concern with utilization is affected by general economic conditions. When aggregate demand or the pace of economic growth slackens, general under-utilization of manpower resources may occur. In contrast, in times of acute shortages attention shifts to problems of better allocation of limited manpower resources. However, the question of utilization retains its importance regardless of the economic situation if viewed in the light of its contribution to the potential for economic growth. Better utilization contributes to greater achievement of economic well-being through the most effective use of relatively scarce human resources.

One of the most pressing needs at this time is for better criteria for judging "good" or "bad" utilization. These are harder to set in a free society which gives priority to individuals freely to choose the occupation they will follow or the industry in which they will work. This suggests the need to create a climate in which rigidities are removed and the range of choice extended.

There is a need for policy-makers to know more about the alternative costs and benefits of various programmes of manpower development and utilization. This can be illustrated with reference to a lack of correspondence between supply and demand. Workers may not be qualified to fill certain jobs, while at other times the jobs for which they are qualified may not exist where the workers happen to live. The result is that the country is below its level of production possibilities, but the policy implications in the two cases are quite different. In the first case additional training, re-training and education may be appropriate, and while the second requires improved geographic mobility.

The integration of manpower functions into one agency in Canada has created a potential for much greater knowledge of the world of work - knowledge which can be communicated by the manpower authorities to those who are concerned with educational planning. This enhances the possibilities for better adaptation and utilization of the labour force in the future.

In Canada, federal manpower agencies are a very important part of those institutions concerned with better human resource development and utilization. Manpower policies in turn are only part of general economic and social policies which aim at an increasing human welfare. It is hoped that the new institutional arrangements for the co-ordination and integration of manpower policies in Canada will provide a better climate for the achievement of these objectives.

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